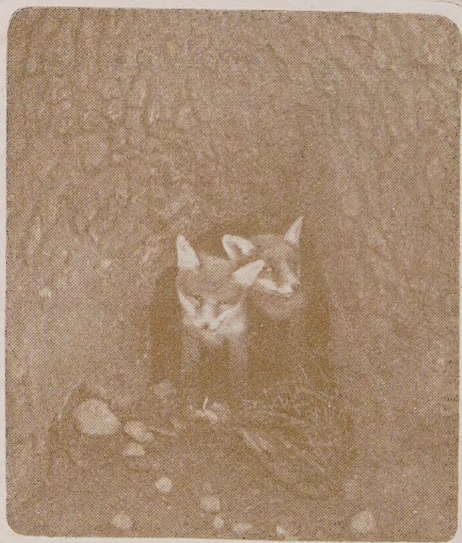


ANIMAL LIFE OF THE BRITISH ISLES



A COMPLETE POCKET GUIDE
WITH DESCRIPTIVE TEXT
BY EDWARD STEPHENS



Stack



10/6 *mad*

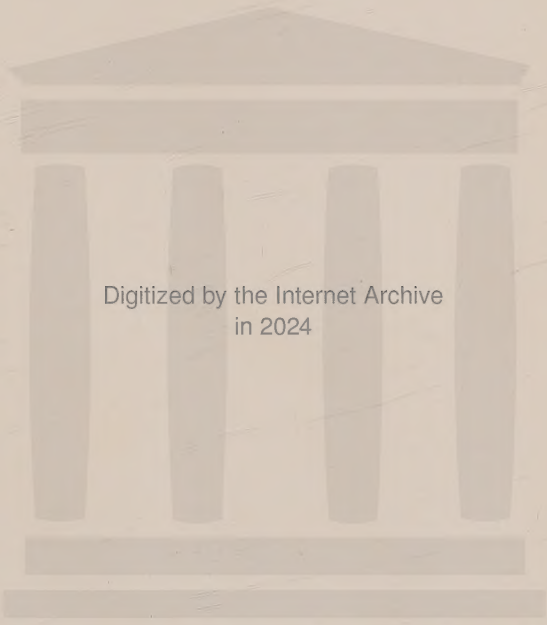
THE WAYSIDE
AND WOODLAND
SERIES

THE HORTICULTURAL COLLEGE,
SWANLEY, KENT.

ANIMAL LIFE
OF
THE BRITISH ISLES

1147

WITHDRAWN



Digitized by the Internet Archive
in 2024



THE HORTICULTURAL COLLEGE,
SWANLEY, KENT.

ANIMAL LIFE

OF THE BRITISH ISLES

A POCKET GUIDE TO THE
MAMMALS, REPTILES AND BATRACHIANS
OF WAYSIDE AND WOODLAND

BY
EDWARD STEP, F.L.S.

AUTHOR OF
"WAYSIDE AND WOODLAND TREES"
"WAYSIDE AND WOODLAND BLOSSOMS," ETC., ETC.

WITH
111 PLATES FROM PHOTOGRAPHS
INCLUDING 48 IN COLOUR
BY W. J. STOKOE

LONDON
FREDERICK WARNE & CO. LTD.
AND NEW YORK

1921

"The lusty life of wood and underwood,

.
The tawny Squirrel vaulting through the boughs,
The Deer, the high-back'd Polecat, the Wild Boar,
The burrowing Badger."

TENNYSON, *The Foresters*.

PREFACE

IT is unnecessary to say much by way of Preface to the present volume, the series of popular handbooks of which it forms part being so widely known to Nature-lovers. The same methods of treatment that were followed in the previous volumes have been pursued here, though the smaller number of species falling within its scope has allowed a fuller consideration of each.

With the exception of the birds (dealt with in Mr. Coward's companion volumes), all the terrestrial animals endowed with a bony framework are included. There are, indeed, a few other native mammals that might have been described ; but as they are restricted to the sea it was felt to be undesirable to include their life-histories in the "Wayside and Woodland Series."

The Author and Publishers desire to express their thanks to the undermentioned naturalist photographers who have contributed their admirable work for reproduction, viz.: Mr. Douglas English, F.Z.S., for Plates 1, 5, 6, 10, 11, 12, 14, 15, 17, 20, 23, 25, 26, 27, 37 to 41, 46, 47, 48, 50, 53 to 62, 65, 66, 69, 70, 71, 75, 84, 89, 90, 93, 96, 97, 98, 101, 103, 104, 105, and the lower photograph on Plate 109. To Mr. Oxley Grabham

for Plates 3, 4, 7, 8, 21, 24, 28, 30, 32, 43, 49, 52, 63, 85, 94, 95, and 107. Mr. Riley Fortune for Plates 16, 19, 33, 45, 51, 77 to 80, 82, and 88. Mr. Charles Reid for Plates 2, 34, 35, 42, 64, 73, 76, and 83. Mr. Stanley C. Johnson, B.A., for Plates 92, 99, 100, 106, 108, 110, 111, and the upper subject on Plate 109. Mr. E. W. Taylor for Plates 18, 86, and 91.

The Author's own contribution consists of Plates 9, 13, 22, 29, 31, 36, 44, 67, 68, 72, 74, and 87.

The appearance of 48 of these photographs in the natural colours is due to the skilful work of Mr. W. J. Stokoe.

CONTENTS

	PAGE
PREFACE	v
INTRODUCTORY	1
INSECT-EATERS: MOLE, SHREWS, AND HEDGEHOG	9
FLYING MAMMALS: BATS	30
FLESH-EATERS: FOX, BADGER, OTTER, WEASELS, MARTENS, AND WILD CAT	52
GNAWING ANIMALS: RABBIT, HARES, DORMOUSE, VOLES, MICE, RATS, AND SQUIRRELS	78
HOOFED ANIMALS: RED DEER, FALLOW DEER, AND ROE DEER	124
LIZARDS AND SLOW-WORM	136
SNAKES	146
AMPHIBIOUS ANIMALS: FROGS, TOADS, AND NEWTS	157
CLASSIFIED INDEX TO ORDERS, GENERA, AND SPECIES	179
GENERAL INDEX	181



INTRODUCTORY

APART from the birds and the fishes, the vertebrates or back-boned animals of the British Islands constitute a very select group. Within the historical period several former notable members of that company have ceased to be represented in the freedom of nature in this country, and their forms can be studied only in museums and zoological gardens. Although we have to regret the absence from our list of the Beaver and the Wild Boar, the Ure-ox and the Short-horned Wild Ox, the Brown Bear and the savage Wolf, there are still sufficient of our vertebrates left to give a zest to the observations of the rambler in the woodlands, over the mountains and along the quiet waysides and streams of our country.

To observe these mammals, reptiles, and batrachians we must go afoot: the bicycle or the motor-car is of use only to convey us quickly out of town to appropriate localities in the open country. Arrived there, quietness must be the order of the day—the footfall light and the voice lowered in conversation if there are two or more in company. The sitter will see far more than the man who wants to perambulate the entire wood or explore the acreage of moorland. A comfortable seat having been chosen with deliberation for the view it affords of a wood margin, a hillside, or stream curve, according to the habits of the creatures we are hoping to see, the field-glass should be brought into requisition, and every inch of the field of vision carefully and repeatedly scanned. The movement of a grass-blade, the trembling of a fern frond or the rustling of a

dead leaf will often indicate the precise spot to be watched. It will be understood that as most of these creatures are more or less nocturnal in their activities, observation must be continued until sometime after dusk at least, in order to be successful.

If the observer is new to this work, he should endeavour, if possible—on the first occasion at least—to get as companion a friend who has already some experience of field-work. A day with such a companion will do more to open his eyes than a whole chapter of printed hints; for it is as true to-day as it was in 1855, when Charles Kingsley wrote in his “Glaucus”—“The greatest difficulty in the way of beginners is (as in most things) to ‘learn the art of learning.’ They go out, search, find less than they expected, and give the subject up in disappointment. It is good to begin, therefore, if possible by playing the part of ‘jackal’ to some practised naturalist, who will show the tyro where to look, what to look for, and, moreover, what it is that he has found: often no easy matter to discover.” On that last point the “Wayside and Woodland Series” has done much to simplify matters.

Respecting the utility of taking an interest in these fellow inhabitants of our country, one of the intellectual giants* of the Victorian Age described Natural History “as the greatest of all sources of that pleasure which is derivable from beauty. I do not pretend,” he says, “that natural-history knowledge, as such, can increase our sense of the beautiful in natural objects. I do not suppose that the dead soul of Peter Bell, of whom the great poet of nature says—

“ ‘ A primrose by the river’s brim,
A yellow primrose was to him—
And it was nothing more,’

would have been a whit roused from its apathy by the information that the primrose is a Dicotyledonous Exogen with a monopetalous corolla and central placentation. But I advocate

* Huxley.

natural-history knowledge from this point of view, because it would lead us to *seek* the beauties of natural objects, instead of trusting to chance to force them on our attention. To a person uninstructed in natural history, his country or sea-side stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of natural history, and you place in his hands a catalogue of those which are worth turning round. Surely our innocent pleasures are not so abundant in this life that we can afford to despise this or any other source of them. We should fear being banished for our neglect to that limbo, where the great Florentine tells us are those who during this life 'wept when they might be joyful.'"

Some of the species described have a very limited range in our country at present, the Deer, for example, being restricted as wild animals to-day to the Scottish mountains and glens and the West Country moors, but even these may be studied as tolerably free animals in the New Forest, Epping Forest, and in many parks such as those at Windsor and Richmond, as well as in private domains. To the Deer we must add the Wild Cat, the Pine Marten, and the Alpine Hare as mammals that must be sought in special restricted areas; but most of the others may be reckoned to be met with, sooner rather than later, in our country rambles.

In view of the practice usual in natural histories of arranging the vertebrate animals in a series with the Birds separating the Mammals from the Reptiles, it may at first sight appear incongruous to bring the latter classes together as we have done; but to the present writer the fitness of this arrangement is quite clear. It is widely held that the Mammalia—the highest class of vertebrates, and therefore the most complex of all animals—have been evolved from an extinct group (*Theromorpha*) of Reptiles, whose remains are found in strata of the Permian and Jurassic Periods. There are, it is true, similar evidences

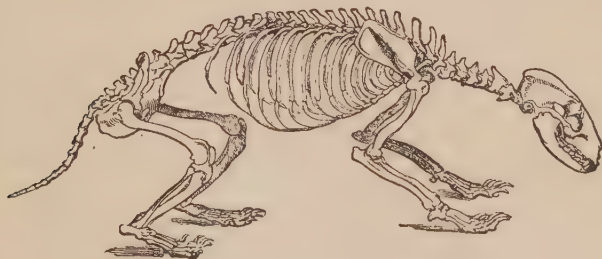
furnished by the rocks showing that the Birds had a reptilian origin; but the Birds did not form an evolutionary stage between the Reptile and the Mammal, but evolved side by side with the latter.

The existing British Mammals represent the six orders insectivora (shrews, mole, and hedgehog), Chiroptera (bats), Carnivora (beasts of prey), Rodentia (gnawing animals), Cetacea (whales and dolphins), and Ungulata (hoofed animals). These all agree with the Reptiles and Batrachians in having a many-jointed internal skeleton, a bony framework giving support to a system of powerful muscles; and of this framework the most important feature is the long backbone or vertebral column consisting of a number of bony rings jointed together by outgrowths or "processes," and held in position by strong ligaments. This attachment of the rings by their flat surfaces produces the spine or vertebral column, with a canal on its upper half in which lies the spinal cord. This column, for descriptive purposes, is divided into regions—cervical, dorsal, lumbar, sacral, and caudal. The number of rings or vertebræ in each region varies somewhat in the different classes and orders, but as a rule the cervical or neck vertebræ are seven; the dorsal, to which the ribs are connected, are about thirteen (extreme numbers are nine and twenty-two); the vertebræ of the lumbar or loin region are usually six or seven, but they vary inversely to those of the dorsal from two to twenty-three; the sacral vertebræ (about five) are in the adult fused together into a solid bone (sacrum) of triangular shape; the caudal vertebræ vary from three (man) to nearly fifty, according to the length of tail common to the genus or species.

In front of the neck is the skull, in the Mammals a bony case containing the brain and organs of sense, made up of plates interlocking by their zigzag margins; in the Reptiles and lower vertebrates a more or less open framework. The lower jaw, or mandible, is in adult Mammals the only part of the skull that

is separate. Its hinder ends work in cavities on the lower part of the skull, and are held in position by strong ligaments and muscles.

The ribs are attached to the dorsal vertebræ, and connect by cartilage at the other end with the sternum or breastbone—really a series of united bones in the middle line of the chest (thorax). The blade-bones (scapula) of the fore-limbs are attached to the upper ribs by the flat or concave side; and the hinder limbs are connected strongly to the sacrum by means of the hip-bones which are united below to form the pelvis, to



Skeleton of the Common Badger.

which the thigh-bone is jointed. The Reptiles and Amphibians exhibit some differences in their skeletal structure which will be pointed out later.

In the matter of teeth there is great diversity among the Mammals—even in the small number of British species. With a view to a proper understanding of the teeth in, say, the Rodents and the Ungulates, it is necessary to write a few words respecting tooth-structure. Although in adult Mammals the teeth are so intimately connected with the jaw as to appear outgrowths from it, this is not the case really. They originate in the skin which covers the jaw, and the most effective part of their structure—the enamel—is derived from the epidermis, the

outer layer of the skin. The centre of each tooth is filled with pulp, around which is the bone-like dentine with an outer coat of hard, glossy enamel. In the incisors or cutting teeth of the Rodents, while the front of the tooth is protected by a thick plate of hard enamel, the back portion consists only of dentine which wears away whilst the enamel front maintains a chisel-like cutting edge. In the grinding teeth or molars, especially noticeable in the Ungulates, the enamel is thrown into ridges and tubercles, so that the action of these in the upper and lower jaws upon each other is like that of "the upper and the nether millstones" in grinding corn.

Four forms of teeth are recognised in the Mammals: the incisors in the front of the jaw, the pointed, round canines or "eye-teeth" next to them, and at the sides the cheek teeth, separated into premolars and molars. In describing the teeth in any species a simple formula is adopted which shows at a glance the number of each kind in one side of each jaw. Taking our own normal dental equipment as an example, it would be expressed in this fashion:—

$$i \frac{2}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 32$$

the upper figures representing the number of each kind in the upper jaw and the lower figures the teeth of the lower jaw, and the total being reached by multiplying by two for the two sides of the skull. Often in our rambles we may come across the skull of some animal, and an examination of the teeth will help us to the identity of its late owner.

For the purposes of the present work it is unnecessary to enter minutely into all the characters that distinguish the Mammals from the other back-boned animals. One is really sufficient—the possession of glands (teats) in the skin of the female which secrete milk for the nourishment of the new-born young. There are, in addition, differences in the structure of the skull and the articulation of the lower jaw. The skin is

always more or less clothed with hair. The heart has a single left aortic arch, the blood is hot, and the heart and lungs are lodged in a special cavity separated from the abdomen by a muscular partition known as the diaphragm.

Respecting one item in the foregoing—it has been said truly that the possession of a few or many true hairs as outgrowths from pits in the skin is alone sufficient to distinguish a Mammal from any other animal. Although these hairs may take different forms, they are alike in their origin—even, to take an extreme case, the spines of the Hedgehog. Each hair consists of an outer wall enclosing a central cavity filled with pith, in which is the dark pigment which gives the hair its colour. In the Mammals this pigment is always brown, and the varying tints of the hairs—black, brown, tawny, cream-colour or white—depends upon the amount of pigment and its disposition in the pith, combined with differences in the density of the envelope. In some cases, as about the mouth, eyes, and ears of the Cat, long sensitive hairs are connected with the terminations of nerves, which help the animal to feel its way. There are no marked colour differences in the fur of the sexes, such as we find in the plumage of Birds; though we do find such discrepancies in the presence or absence of horns in Deer, and in the manes and hair-tufts of some exotic Mammals. Certain species, such as the Alpine Hare and the Stoat, undergo a marked seasonal change of colour in the fur under the influence of low temperature. This may be quite sudden, owing to a rapid fall of temperature, and—as shown by Metchnikoff—is effected by the pigment granules being consumed by a sort of phagocyte. By Metchnikoff's researches an old controversy appears to have been settled finally.

ANIMAL LIFE OF THE BRITISH ISLES.

Hedgehog (*Erinaceus europæus*, Linn.).

The Hedgehog, Urchin or Hedgepig is so distinct from every other British mammal, that anybody could correctly name it at sight. The development of many of its hairs into long, stiff spines gives it an individuality that is not to be confused with any other ; but there are other peculiarities, such as the extreme shortness of the head and neck in comparison with the bulk of its body, and the muscular power that enables it to remain rolled into a ball with every part protected by erected spines. But for the fact that the Hedgehog is frequently introduced into houses and gardens to keep down insect pests, few town-dwellers would have had the opportunity of seeing the Hedgehog alive ; for it is a nocturnal beast coming from its retreat only at dusk and hunting through the night. There are, however, exceptions to this rule when a heavy summer downpour of rain has drenched the herbage and caused the snails and slugs to show considerable activity. Then the Hedgehog awakens also, and reduces their numbers ; for it is with such fare, plus insects, worms, mice, rats, frogs, lizards and snakes, that the Hedgehog maintains his portliness. He passes the day under a heap of dead leaves or moss in a spinney or thick hedgerow, and the solitary observer in such places may sometimes be guided to this retreat by his snoring !

The winter time is spent as a rule in continued sleep ; though he has been known on mild nights in winter to wake up and prowl around for the very few good things then to be found. But he is no intermittent hibernator like the Squirrel and Dormouse ; therefore he makes no provision by laying up winter stores, which are only possible for seed-feeders. For his winter retreat he looks out for a hole in the bank—perhaps one that has been gradually enlarged by a colony of wasps to accommodate their continually increasing nest—and this he lines with dry leaves and moss, carried in by the mouth. Then he snuggles into his bed and goes to sleep until the spring.

The Hedgehog's eyesight does not appear to be very good, but this is made up to him by a very acute sense of smell. He hunts along the hedgebottoms and the sides of ditches, and in some localities he is frequently to be seen in such situations. But we have met with signs of his presence high up on the moors where he finds dense cover among the heather and bilberry. His common diet of snails and beetles is varied by the eggs of the robin and meadow pipit, and occasionally he stumbles upon a huge store of food in the shape of a dozen or more eggs of pheasant or partridge. By depressing his spines he may even find his way between the bars of a hen-coop, but after eating a great part of the hen he may be too portly to get out, and then falls a victim to the enraged poultry-farmer. He is, of course, too short-legged to accomplish the operation formerly attributed to him—that of milking cows—unless, of course, the cow assented to the robbery and laid down to it. But no evidence has been given in support of the charge, which is of kindred nature to the aspersions of Pliny, Ælian and other of the ancients that it climbed apple and fig trees, gathering and throwing down the fruit, then throwing itself down so that its spines would impale its plunder with which it walked off. One weak point in the story is the fact that the Hedgehog has no use for such fare as apples, and as for the milk—any one





Pl. 3.

Female Hedgehog
With her family of young ones.

inspecting the small gape of his mouth would exonerate him from the charge of getting a cow's dug into it.

He is said to be capable of killing and eating a wild Rabbit ; but, of course, although he runs well, he could never catch a Rabbit unless the rodent were wounded. He is also a good swimmer and climber, not only of trees but of rain-pipes and rough walls, especially where these are creeper-clad. In addition to the food mentioned above he takes slugs and worms, mice, rats, lizards, frogs, and snakes—including the Viper to whose poison he is immune. It is certain that it fights with Rats, and Lord Lilford has told how it cleared a garden of them ; but the Rat is sometimes the victor and eats the Hedgehog. The Hedgehog on occasion will indulge in a feast of carrion.

Only animals that are very hungry will attack the Hedgehog, and then the young are preferred if available. Gipsies, Foxes, and Badgers appear to be his principal enemies. The Fox is said to have a special and disgusting method of making the Hedgehog unroll when he is on the defensive ; and a writer in *The Field* some years ago stated that when caught by the Badger the Hedgehog utters a pitiful wail, though he will permit himself to be torn to pieces by a terrier without a cry.

The male and female are known respectively as Boar and Sow, to carry out the idea that they are a lesser kind of pig. Though the males are very quarrelsome among themselves, they have the domestic virtue and mate for life. Some time between the end of June and the end of August, the female produces a litter of four to seven blind and helpless young, sparsely clad with pale, flexible spines, and the ears drooping. The spines gradually stiffen and become first dull grey, then brown and ringed with three bands, of which the middle one is dark and the others light. The spines are arranged in radiating groups, surrounded by coarse harsh fur. Normally, these spines lie flat upon the body, but can be erected at will. They cover the entire upper surface with the exception of the short conical head

and stumpy little tail—which is shorter even than the short rounded ear. The head and underside are clothed with harsh fur of a dirty brown or dirty white colour. In Devon and Cornwall it is known as Furze-a-boar. It expresses its feelings by means of a quiet grunt ; the youngsters by a squeak.

The adult male Hedgehog is about nine and a quarter inches in measurement of head and body, and the tail is a little over an inch ; the female is less than the male by about three-quarters of an inch. In relation to its entire bulk—it weighs one and a half pounds—the neck and body are said to be shorter than in



Skeleton of Hedgehog.

any other British mammal. The eyes are bright and prominent. The legs are so short that the body but little more than clears the ground in walking. Both hand and foot has five clawed toes, and five pads on the sole.

The sharply pointed spines are about three-quarters of an inch in length. They are quite hard, and have from twenty-two to twenty-four longitudinal grooves. They have a hemispherical base above which is a narrow neck sharply bent, so that the spine is almost at right angles with the base.

When attacked the Hedgehog has the skunk-like habit of emitting a highly objectionable odour in order to disgust its assailant.

We have never tried Hedgehog-meat as food, but several well-known men have testified to its excellence when cooked gipsy-fashion—in a crust of clay.

The dentition of the Hedgehog is $i \frac{3}{2}$, $c \frac{1}{1}$, $pm \frac{3}{2}$, $m \frac{3}{2} = 36$.

With the Hedgehog we make our acquaintance with the order Insectivora, which is represented in Britain by five species only: the others being the Mole and three Shrews. In many respects they are similar to the Rodentia, but the incisor teeth have not the chisel-shape of the latter, and the molar teeth instead of having grinding crowns have them developed into pointed eminences more suited for piercing the chitinous armour of beetles, etc. The skeleton is furnished with clavicles or collar-bones. There are five toes on each of the feet, furnished with claws, and the animal walks on its soles. Our native species represent three distinct families: *Erinacidae* (Hedgehog), *Talpidae* (Mole), and *Soricidae* (Shrews).

Mole (*Talpa europæa*, Linn.).

However slight may be their personal acquaintance with the Mole himself, his engineering work is only too evident to every possessor of a garden. He may, perchance, live in a neighbour's land, but from time to time we shall find some morning that he has driven a tunnel right across the lawn or the tennis-court, marring its hitherto fair surface with an ugly ridge and at intervals a little heap of raw earth. If we are sufficiently self-controlled to dissemble our inward rage, we may get some countervailing good out of the calamity. If we bring a garden chair and sit quietly within range of the newest heap, our quiet watching may be rewarded by a sight of the clever little engineer, and we may be restrained from throwing stones at him by the thought that he is seeking to reduce the number of those worm-casts on the lawn that have always annoyed us so.

If the tunnelling work is not yet completed, we shall see a

heaving of the fresh heap of soil, and after a short interval the sharp, black snout of the Mole will be pushed up from the centre to sniff the air and ascertain if it is safe for him to make a fuller appearance. Satisfied that it is so, he exhibits his shoulders and the broad shovel-shaped hands with which he has accomplished all this navigator's work. Now he is right out, even to his ridiculous little tail, and so to speak swimming over the turf—for he cannot walk on his fore-feet, the hands being set sideways for his shovelling work.

Why has he come up? We can only surmise that he is satiated with the luscious earth-worms and beetle-grubs that live under our lawn, and is looking around for some more substantial fare—a dead bird or mouse, perhaps, for he is by no means averse from picking bones for a change, though his structure makes it impossible for him to catch any of the vertebrates alive, but he can kill and eat a smaller or weaker Mole, and has been reported to attack birds, lizards, frogs, and snakes; he will not touch vegetable food. His appetite is almost insatiable, and there is little substance in his underground fare, which impels him ever to increase his sources of supply by boring fresh runs. There! your movement alarmed him, and he has dived to earth again in the soft mould of the border.

It is not only in the garden that we may see the Mole and his work. He is perhaps more active in the meadow and the cornfield, where he has a wider range for his long straight main run and the side runs that branch off from it. In either of these places he is actually much more of a nuisance than in our garden—difficult though it may be for the garden-owner to realise this. When the hay or the wheat has to be reaped the lines of hillocks across the field are an impediment to the reaping machines. So the farmer has to set traps to minimise the nuisance as much as possible. When these are of the bent hazel rod and noose variety we may find the trapped Mole

swinging from the rod that has straightened itself, and can then indulge in a close inspection of his form and structure. In pasture-land the mole-hills often appear to occupy more space than the intervening surface.

The velvet-clad body is cylindrical, with the fore-limbs set well forward opposite the short neck. The long muzzle is blunt-pointed and terminated by the nostrils, which are close together. His eyes are mere points that have to be searched for among the close fur, and the same applies to the ears which have no external shell. Shakespeare, who thought the Mole sightless, was aware of his acute sense of hearing—

“ Pray you, tread softly, that the blind Mole may not
Hear a footfall.”

The flexible snout is adapted for turning up the earth after the immense hands with their large, strong nails have loosened it. They are wide-open hands that cannot be closed and the palms always face outwards. The hairs constituting the velvety fur are all set vertically, so that they will lie forwards or backwards or to either side; and the colour appears to change according to our point of view—two persons viewing the same Mole can describe it correctly as black and as grey. It is really a dark grey.

The teeth should be examined. In the upper jaw there are six incisors of equal size—three on each side—two comparatively large canines of triangular shape and flattened from the sides, eight little premolars and six molars. In the lower jaw the dentition is somewhat puzzling, as the canines are similar to the incisors and the first premolar is developed into a suitable mate for the upper canine. These are not teeth designed for gnawing like those of the Rat and Rabbit; they are for biting insects and other small creatures, and agree in general with those of the Shrews. The formula stands thus:

$$i \frac{3}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{3}{3} = 44.$$

The adult Mole is a slave to his appetite, and if kept without food for only a few hours he dies of starvation. Knowing this, the old writers averred that he kept a store of bitten worms so that he might draw upon it on emergency ; but this statement has never been substantiated by careful observers.

Every one is familiar with the diagrams of what was styled fancifully the Mole's Fortress, as though it were a stronghold held by force against an enemy. There is really no more reason for calling it a fortress than for applying the same term to a Rabbit's burrow or a bird's nest. The idea upon which the originators of the fortress story worked was that the mole-hill was a place of intricate passages where the invader could be given the slip. Le Court, the French inventor of the term, whose account was published by Antoine Cadet de Vaux in 1803, described its interior as having a central chamber surrounded by two galleries, one above, the other below, connected by five nearly equidistant passages. From the upper and smaller gallery three similar passages gave access to the central hall, at the bottom of which was a bolt-hole communicating with the main run. Plans and elevations, as an architect would describe them, were made of these details, and for a hundred years every writer on the Mole reproduced these illustrations without doubting their absolute accuracy. It was so much more easy to accept them than to patiently explore and accurately draw the actual structure. Of course, what these writers described as a fortress must not be confused with the "mole-heaves" or "tumps" thrown up at frequent intervals to get rid of the earth from a newly excavated run. These are only a few inches in height. The home of the Mole—the mole-hill proper—is about a foot high and about three feet broad in any direction. This, as a rule, will be found partly sheltered by a bush, sometimes well out in a pasture, and always on the line of the Mole's high-road, which lies deeper than the newer side runs he is always excavating for





hunting purposes. These are but little below the surface, in the richer soil where there are more worms and grubs and where the dug-out earth is easily pushed up to the surface by the pressure of his head.

Moral writers used to commiserate the poor blind Mole for having to expend its energies in ceaseless toil in the dark underground, and then rhapsodise on its marvellous adaptation to its rôle in nature, getting lost in admiration of the mathematical skill displayed in the construction of the "fortress" they had never seen and which was largely an imaginative piece of engineering. It is true that its body may be said to fit the tunnels it has excavated, though it might be more accurate to say that the tunnels are modelled upon and by the Mole's form, for it is the constant passage of the animal backwards and forwards that smooths and consolidates their walls. The sense of sight is of less importance to it than that of smell, which is apparently its most highly-developed sense, though that of hearing is very acute.

Although the eyes are complete in the sense that eyeballs and lenses are present, they are so small and so completely surrounded by fur that it does not appear that the Mole can get any great advantage from their possession, even when he is above ground. The diameter of the eyeball is one millimetre—that is, considerably less than the head of a "short white" pin!

At the end of the last century, my friend Mr. Lionel E. Adams set himself the task of providing some more reliable information as to the life-story and habits of the Mole, and in four years of research did not hesitate in the interests of science to break in upon the digger's privacy in order to explore his so-called "fortress," and the nursery of Mrs. Mole. He was not content with cutting sections of two or three of these erections; he examined three hundred of them, finding a considerable variation in their arrangements, but not one of them was like

the familiar drawings in the books of Thomas Bell and J. G. Wood, copied from French authors.

Mr. Adams experienced great difficulty in making these observations owing to the nature of the subject, but he persevered and made plans of sections from a hundred of the three hundred hills he explored, and found that no two plans were alike. Some were very simple, others exceedingly complicated, "but," he says, "in no case have I found one to tally exactly with the time-honoured figure originating from Geoffroy Saint-Hilaire, elaborated by Blasius, and copied from him by every succeeding writer, apparently without the slightest attempt at verification."

But even in those cases where there is some approach to the plan of the old diagram, Mr. Adams found that it was clearly not due to any scheme for constructing a baffling system of bolt-runs for defensive purposes, but purely incidental to the work of excavating the nest cavity and getting rid of the material dug out. The easiest way to dispose of this redundant earth is to push it to the surface, and to do this a tunnel has to be made above the nest cavity. This, as a rule, is originally only from two to six inches below the surface, but the hoisting out of the surplus earth causes the formation of a solid dome of considerable thickness above it. The tunnels thus made to get rid of earth usually end in blind terminals, and would not be available for escape in the case, say, of the "fortress" being entered by a Weasel. It is notable that in the only one of Mr. Adams' plans that approaches nearly to the old figure there is no connection between the "galleries" and the nest cavity.

In some soils (like the Bunter Sandstone) Adams found that stones of four ounces are turned out—that is, equal to the average weight of an adult Mole. He also found that "the softer the soil, as a rule, the nearer are the runs to the surface."

In his work "*De la Taupe*," de Vaux says: "The Mole



Pl. 6.

C 18.

Mole making a new burrow.

When alarmed above ground it dives rapidly into soft earth.



Pl. 7.

In the Mole's Nursery:
The young have wrinkled pink skin.

places his habitation in the most favourable spot in his cantonment ; he studies everything, and never does he make a mistake except under circumstances which he has been unable to foresee, such as continuance of rains, a flood ; then he makes up his mind promptly, and establishes himself elsewhere. It is by preference that he places his fortress in the foundation of a wall, under a hedge, at the foot of a tree."

Upon this Adams has the following comment:—

"With regard to a deliberate choice of 'the most favourable spot' after a survey of the cantonment by a practically blind animal of the Mole's impatient disposition and subterranean habits, there can be no question as to its absurdity."

The male and female (Boar and Sow) appear to associate only temporarily, the female being polyandrous and constructing her own nest-hill, which is smaller and of more simple plan than the male's winter retreat and seldom has a bolt-run. Her hunting tunnels are winding as compared with the long straight runs of the male. The nest is a ball of leaves and grass, all having to be carried in by the mouth. The chief pairing season is at the end of March and beginning of April, and the young are born about six weeks later. The number of young in a litter varies from two to seven, the average is three or four. They are blind, naked and pink, but before the fur has begun to appear the skin has darkened to a bluish slate colour. The eyes open about the twenty-second day.

The Mole does not appear to be definitely hunted by any enemy—save man!—although killed by Weasels, Herons, Owls, Fox, and Badger when they come across him. Adams thinks that for all practical purposes the Mole may be considered blind ; that if its eyes were not covered by fur the low position of its head would prevent it seeing beyond an inch or so. He is convinced that worms are hunted by scent. The Mole is an excellent swimmer, and can attain to a similar speed in the water to that of the Water Vole.

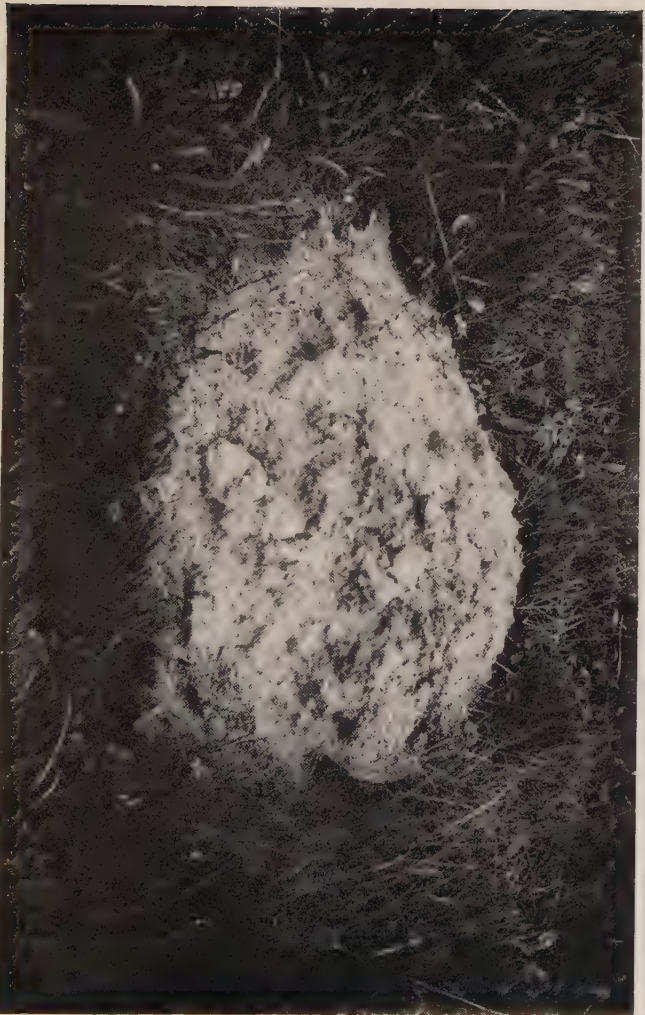
The Mole does not hibernate: the demands of his appetite appear to preclude the possibility of a long fast, even if dormant.

Old names, still extant in some districts, are Moldwarp, Moudiewarp, Wunt, Want (in the "Epinal Glossary" of about A.D. 700, spelled Wand). Its feet, carried in the pocket, are a rustic specific for rheumatism.

Though Adams refrained from eating adult Mole, warned as he tells us by the dark flesh and musky odour, he experimented with a couple of milk-fed young, ten days old, and had them boiled. Eaten without salt or other condiment, he says he "found them excellent, much like Rabbit, the flesh being white and very tender."

The Mole's position in human regard has always been equivocal. The gamekeeper has accused him of sucking partridge's eggs, and the farmer has pointed to his young wheat plants turned out of the ground as the Mole ran a surface furrow across the cornfield. Against this in former days the farmer would credit him with the wholesale destruction of earthworms; nowadays, however, the farmer has more enlightened views on the subject of earthworms, and their destruction must go into the debit side of the account. But the Mole does not live on worms alone, though chiefly: his runs must cross the track of many a grub—wireworm, leather-jacket, and fat cockchafer-grub, for examples, and slugs and snails on the surface—that the farmer would gladly have removed; and it is not likely that the Mole pushes such fare from him untasted. Then, again, one must remember the agricultural value of the little black engineer who carries out so efficient a system of surface drainage, and improves the pasture by bringing to the surface fresh soil from below. There is, however, no mercy shown, no redeeming virtue admitted, in the case of the Mole who sins against society by running his tunnels under the tennis-lawn or golf-green, and spoiling their levels by thrusting up his unsightly rubbish heaps.

Pl. 8.



External view of Mole's Nursery.

It is smaller and of simpler structure than the so-called "fortress."

C. 20.



Common Shrew.

Sorex araneus.

So enormous numbers are killed yearly ; and the Mole-catcher boasts of his great annual catches. But the astute Mole-catcher refrains from destroying the nests, for were he to do so his occupation would be gone. The Mole squeaks much like a Bat or Shrew.

The Mole appears to be plentiful in all parts of England, Wales and Scotland, wherever there are earthworms ; it has been found even at an elevation of 2,700 feet. But it does not occur in Ireland, the Shetlands, Orkneys, Outer Hebrides, or the Isle of Man.

Colour variations have been recorded including cream, orange-pink, whitish with markings nearly black, orange or yellowish, as well as wholly grey, fawn or ash-coloured.

Common Shrew (*Sorex araneus*, Linn.).

Along the hedge-bank, the ditch-side and the edge of the spinney in the evening, may be seen one of the smallest and prettiest of our mammals, a minute dusky red-brown creature with long flexible pointed snout turned up ever and anon to reach an insect on the grass-stems. Although he has bright bead-like eyes his range of vision is very short, and if we keep quiet and undemonstrative we can watch him without his being aware of our presence.

This is the Common Shrew or Shrew-mouse, an inoffensive and useful creature, for its food is restricted to insects, snails, woodlice and the other small fry that annoy man without the latter being able to do much in retaliation. As he sits there among the long-stalked trefoils and nodding flowers of the wood-sorrel we are able to get a good view of him.

With a combined length of head and body amounting only to three inches, his long hairy tail adds nearly half as much again—but the tail length varies a good deal in different individuals. His bilobed snout extends far beyond his mouth, and

is well furnished with whiskers. His hind-foot—a distinguishing feature in the Shrews—measures just over half an inch. He is clad in a coat of soft, close, silky fur whose dark upper part pales to dirty yellowish grey beneath, and his hairy feet and tail are flesh-coloured. The dark coloration may vary to almost or entirely black. The hairs on the tail are short and stiff, almost like little spines. A gland on each flank, midway between elbow and thigh, provides the disagreeable musky odour which is its sole protection against enemies.

In winter he spends his time in hedge-bottoms and copses among the dead leaves, but not in sleep as stated often. In summer he moves out into the fields and rough pastures, where there are tufts of coarse grass in which he can take cover, and from which he makes runs through the surrounding grass. Here he may be seen at times actually climbing the stout grass stems after insects; sometimes he climbs a tree. His toes are well separated, and this enables him to climb. Although the feet are not well formed for digging he can burrow expeditiously in light vegetable soil with the forefeet, and can bury himself in twelve seconds; but, as a rule, he is more inclined to utilise the common underground runs of Mice where these are available. The long, attenuated and sensitive snout, like those of the Pig and Hedgehog, are well adapted for turning over dead leaves and the surface soil in its search for insects, worms, and snails; and its short, soft, velvety fur fits it for passage through the soil without getting dirty. His movements are not nearly so rapid as those of the Mice, and it is consequently a better subject for observation. It is by no means an unusual sight to see it swimming, and in accordance with this semi-aquatic habit, it frequently makes its nest on the banks of ditches. The nursery is a cup-shaped nest woven of dry grass and other herbage with a loose roof beneath which the Shrew makes its entrances and exits. These are frequently uncovered by the mowers at haying time.

The breeding season extends from May to November, and during this period each female appears to have several litters, each consisting of from four to eight or even ten—but usually five, six, or seven—young, although she has only six nipples. Putting it at three litters of six as an average—eighteen in a season—we get an enormous possible increase of Shrew population. Yet the numbers observable from year to year are fairly constant; and in considering the high birth-rate we have to allow for the heavy bill of mortality. Though Shrew-flesh is not to the taste of all carnivorous creatures, and its musky odour makes it actually repellent to some, this does not in all cases protect the Shrew from death. Cats, for example, kill many Shrews, but will not eat one. Dogs also account for many Shrews, and will sometimes essay them as food, though their stomachs refuse to deal with the unpleasant musky morsel.

From the latter part of summer onwards dead Shrews are quite common objects of the countryside; and various theories have been set up to explain the phenomenon, for these dead bodies are mostly without any signs of maltreatment, either by tooth or claw. It has even been attributed to an autumn epidemic afflicting Shrews alone; and to the influence of fear caused by a thunder-clap or the mere breaking of a twig near by. But apart from this mysterious mortality, Owls levy a heavy toll upon the Shrew, as is evident from the indigestible "casts" thrown up by these birds. Other birds of prey, such as the Kestrel, are known to take their share, and a further considerable number are claimed by Magpies, Jackdaws, Stoats, Vipers, and Smooth Snakes. Then, again, numerous males fall victims to the jealous fury of their own sex, which leads to fierce and fatal battles. But, as already stated, there are seldom any indications of such encounters on the bodies of these autumn dead, and the only conclusion that appears tenable is that they have died from what a coroner's jury would term "natural causes."

Mr. Lionel Adams, who has made special investigations into this matter, suggests that the natural cause is senile decay. He points out that young Shrews moult before winter, the process beginning in September and being completed by November, getting a darker and thicker coat than the light brown one they have worn hitherto. The progress of the change can be watched. It begins on the lower part of the back and extends gradually to the neck, head and face. In spring this darker coat is exchanged for a shorter and lighter one. *But in their second autumn there is no resumption of the winter garb!* The natural span of a Shrew's life is fourteen months as the maximum; and Nature does not go to the expense of winter clothing for creatures that will not live to wear it.

So small a body as that of the Shrew does not appear to require much food to keep it going; but the character of the food counts, and apparently insects are not very sustaining. The insect-eater must pursue his prey almost incessantly. We have proofs of this in the ceaseless activity of insectivorous birds, the Mole, the Bats, and the Hedgehog—all insectivorous. Mr. Adams found that, in captivity, a Shrew would gorge for half an hour, then have to sleep for a similar period before renewing its feeding with the same energy. In this case the food was all provided and had not to be chased; and the Shrew was willing to eat the flesh and pick the bones of one of its own kind. In thirty-six hours it consumed food of various kinds equal to nearly four times its own weight. If food is not obtainable for a few hours, the Shrew dies. This excessive demand of the stomach causes the Shrew to be active both night and day. It is fond of carrion, and has frequently fallen a victim to traps baited with bread, cheese, nuts or apple; and, as Mr. Pocock reports, with plum-pudding. He sleeps with the long flexible snout tucked between the forelegs under the chest.

The Shrew's dental formula is $i \frac{1}{2}, c \frac{1}{0}, p \frac{2}{1}, m \frac{3}{3} = 32$. The

summits of the teeth are red-brown, and the almost horizontal lower incisors are encircled by those of the upper jaw.

The Common Shrew is found throughout Great Britain but not in Ireland. Its vertical range is from sea-level certainly to 1500 feet, at which height it has been found in Cheshire by Coward and Oldham. It probably goes higher in our mountain regions, for on the Continent it has been recorded at 6000 feet. It is active all the winter among the dead leaves in some thick hedgerow, where it searches for hibernating insects which are plentiful in such covers. The rambler at this season may have his attention called to the Shrew by its shrill squeak, but like that of the Bats it does not impress all ears.

A form found in the Isle of Islay has been separated as a distinct species under the name of *Sorex granti*.

It is strange that so inoffensive a creature should have been the subject of superstitious malignity in the past. It was reputed to cause lameness by merely running over the foot of man or beast, and as an antidote a Shrew was plugged into a hole bored in an ash tree from which thereafter a twig passed over the afflicted part would effect a cure. Readers of Gilbert White will remember his description of the Shrew-ash that formerly stood "at the south corner of the plestor" at Selborne. The evil reputation of the Shrew was much more ancient than White's day, for the Rev. Edward Topsell, who wrote a "Historie of Four-footed Beastes" (1607), says of it—"It is a ravening beast, feigning itself gentle and tame, but, being touched, it biteth deep and poysoneth deadly. It beareth a cruel minde, desiring to hurt anything, neither is there any creature that it loveth, or it loveth him, because it is feared of all."

Lesser Shrew (*Sorex minutus*, Linn.).

The Lesser or Pigmy Shrew is the smallest of all British mammals. It may be described roughly as a smaller edition

of the Common Shrew, and until recent years was considered to be only the juvenile form of that species, for which, no doubt, it is still mistaken frequently. It appears to be widely distributed in Britain, but is local, the areas in which it occurs being limited and patchy when marked on the map. These are mostly in wooded districts, but extend from sea-level to the tops of our highest mountains, for it has been found on Ben Nevis at a height of 4,400 feet. In Ireland, from which the Common Shrew is entirely absent, its place is taken by the Lesser Shrew, though it is not nearly so abundant as the Common Shrew is in Britain.

Seen side by side these two species are sufficiently distinct, but apart they may be taken as identical. The earlier British naturalists had not learned to discriminate one from the other, and even Bell, as late as 1837, does not mention the Lesser Shrew, though in the second edition of his work (1874) it appears in a description by Alston. If we take average length of head and body in an adult Common Shrew as three inches, we shall find that a similar individual of the Lesser Shrew measures only two inches and a quarter—a reduction of 25 per cent. The hind foot without the claws in the Common Shrew is half an inch, but in the Lesser Shrew it is one-sixth less. The actual length of the tail is about the same in both species, but proportionately there is a difference, for whilst that of the Common Shrew only equals half the length of head and body, in the Lesser Shrew it is equal to two-thirds. But it has been held that the length of the hind feet alone is distinctive, and that “any Shrew in which these reach or exceed 12 millimetres may be set down as of the larger species.”

The colour of the fur is the brown and white of the common species with a fairly sharp line of demarcation between them. Though the animal as a whole is more delicately built, the snout is relatively longer and thicker; the tail also thicker and more hairy; the forearm and hand are shorter. The

sensitive snout appears to be more useful than its eyes in hunting. As the result of his experiments, Adams is of opinion that the sight of Shrews is not much—if at all—better than that of the Mole. Yet it must hunt incessantly for, owing to its rapid digestion, frequent meals are a necessity. It is so delicately organised that it has been found that detention in a trap for only a few minutes is fatal to it ; and captured specimens that have been carried in the hand for a few hundred yards have died shortly after.

It is an excellent climber, and sometimes enters the upper windows of houses. It is more nocturnal in its habits than the Common Shrew ; but is subject to the same autumnal mortality. It does not appear to construct burrows, but utilises those of Mice. Its nests have been found in various situations, such as a clump of rushes, a hollow tree stump or a hollow in the ground roofed by a stone ; and they have been of different materials according with the local conditions, moss, dry grass, fine rush shreds and wood chips variously combined and interwoven to form a hollow ball.

There are probably two litters of from two to eight young, born between May and September.

Water Shrew (*Neomys fodiens*, Schreber).

The Water Shrew is our largest species, the length of head and body combined varying from three to three and three-quarter inches, the body of bulkier build than that of the Common Shrew, and the tail longer than the body. Its upper parts are dark coloured—from slaty black to dark brown—and the light ashy grey or dirty white of the underparts appear pure white by contrast. The snout is shorter and broader than that of the Common Shrew ; the small eyes are blue, and the ears, which are entirely concealed, bear a tuft of white hairs. The brown feet are broader and the digits are bordered with stiff

hairs which make them more efficient as paddles; and the tapering flattened tail of the adult has a double fringe of strong silver-grey hairs along its underside, constituting a "keel" and making it more efficient as a rudder. The hind foot usually exceeds three-quarters of an inch. The fur is finer and thicker than in the other British Shrews; and the upper and lower colour areas are sharply separated one from the other. Its aquatic habits have in some districts caused it to be known as Otter-Shrew. The tail is brown above and lighter below. Variation to full black is frequent, and albinos have been recorded.

The teeth have coloured tips like those of the other Shrews,



Skeleton of Water Shrew.

but the points of the incisors are more hooked than in the two species of *Sorex*; moreover, there are two teeth less, the dental formula standing thus:— $i \frac{3}{1}, c \frac{1}{1}, p \frac{2}{1}, m \frac{3}{3} = 30$. It is these differences in the teeth that has led to the Water Shrew being placed in a separate genus.

In wandering quietly along the streamside we may perchance see the Water Shrew sunning itself on a mossy stone by the margin of the water, for it is active by day as well as by night. We may see it make a sudden plunge into the stream, and present a beautiful appearance under water, for the fur carries a good deal of air entangled in it which gives the submerged body a silvery appearance. It chases the whirligig beetles and watergnats on the surface, or routs at the bottom for caddis-worms and other larvæ. Its haunts may often be detected by the little heaps of caddis cases on the bank, which it has brought



Water Shrew.



Pl. 11.

Common Shrew.

Female beginning to prepare her nursery nest.

C 29.

ashore and emptied of their living contents. It eats other aquatic animals, such as snails, worms, small crustaceans, frogs, and small fishes ; is not averse from a little carrion, and has been caught in a trap that was baited with cheese. It utters a cricket-like chirp not unlike that of the other Shrews.

As he seldom goes more than a couple of yards from the bank, the quiet observer may take full stock of his proceedings, for the limited range of his vision does not permit him to see you. He appears to be very buoyant in the water, swimming with his head slightly above the surface and the body spread out. Though he may walk for a time along the bottom, he never gets his fur wet. At times he makes distinct leaps out of the water, apparently after a flying insect.

His home is a burrow in the bank, and far inside the female lines a chamber with moss and fine roots, or weaves a round nest of grass and leaves where in May or June she brings forth her litter of five to eight minute blind and naked young. These develop rapidly and when they are five or six weeks old they are independent. There is probably a second brood in September. Like the other Shrews the males are great fighters.

He is found sometimes at a considerable distance from the water, apparently seeking a change of diet, or migrating to a more abundant food supply. It does not hibernate, and may be seen in winter pursuing its prey beneath the ice. Its chief enemy is the Owl, whose cast-up pellets frequently contain the skulls of Shrews.

The Water Shrew is much more local in its occurrence than are the other Shrews. With this reservation it may be said to be widely distributed throughout England, Wales, and Scotland ; and in Staffordshire and Cheshire has been found at elevations of a thousand feet. It is not found either in Ireland, the Isle of Man, the Outer Hebrides, the Orkneys or Shetlands. In the Fen country it is known as the Blind-mouse.

Bats (*Chiroptera*).

With the exception of the great class of Birds, the Bats are the only surviving back-boned animals that possess the organs of true flight. Apart from this specialisation for a life in the air the Bats are very similar in their organisation to the Insectivora, and long ago Huxley pointed out that they were exceedingly modified Insectivora; but this modification marks them off sharply from their nearest allies, and the authorities have agreed that it constitutes a reason for setting them apart in a special order—the *Chiroptera* or wing-handed animals.

So complete has been the adaptation to an aerial life, involving both pairs of limbs, that they are no longer fitted for progression on the earth. The fingers of the hand have been so drawn out that they are longer than the forearm, and the middle finger is at least equal in length to the head and body, whilst the thumb has been converted into a hook by means of which the Bat can hang from any rough surface. Over these exaggerated finger-bones a broad web of skin has been stretched, and connected not only to the sides of the body but also to the hind legs as far as the ankle, and then nearly or quite to the tip of the slender tail. The effect of this great modification, whilst it creates a pair of great wings, is to render the hind limbs unfitted for ordinary locomotion, for these are so twisted out of the position assumed in quadrupeds that the knees are turned backwards. This is the cause of the awkward, shuffling movements of a Bat on the ground which make it quickly rise into the air or at least to climb some vertical surface.

Looking at the skeleton of a Bat, we shall find the vertebral column short, the neck short-boned but broad, the spinal cord being of great thickness at this part though reduced to a mere thread at the hips. The ribs are usually flattened and connected to a strong breast-bone, which has a prominent keel for the attachment of powerful muscles controlling the wings. The





Great Bat or Noctule.
Nyctalus noctula.

tail controls the web connecting the hind-legs, which acts as a rudder in flight and as a net, helping to capture and retain the larger insects upon which the Bat lives.

The permanent teeth—which are quite different from the milk-teeth—vary in the different species, but they always have distinct roots, and in the British species the upper surface always runs into points or cusps, suited for cracking the chitinous shells of beetles.

The Bat's brain is considered to be of a low order ; yet its senses are very acute. Spallanzani, in the latter part of the 18th century made a number of experiments on Bats, depriving them



Skeleton of Bat (*Vespertilio*).

of sight, smell, and hearing, and observing their behaviour under such conditions. He found that when released in a room across which he had stretched numerous threads to block their flight, they in every case avoided these, even when directly in their course. They appear to be helped in this matter by the sensitive whiskers around the muzzle, as well as by the delicate membranes constituting the wings and the outer ears. In the Horse-shoe Bats there is also a great development of the appendages to the nose, known as the nose-leaf, which act as delicate organs of special perception.

In most of the genera there is considerable development of the ear as compared with other mammals. The little lobe that guards the entrance to the ear in the human subject, and is known as the tragus, is much elongated in the Bats so that it

becomes a conspicuous feature, and its variation affords one of the characters for identification of the species. Our two Horse-shoe Bats alone are without any prominent tragus.

It is considered that the Bat's powers of flight are superior even to those of the birds. This is especially evident if we watch the rapidity with which it can change its speed, suddenly stopping when in full flight, then making sudden swoops and turning somersaults in a way that would evoke the admiration of the stunt-loving airman. The females as a rule have larger wings and heavier bodies than the males.

Perhaps to the majority of people the Bat appears to be a creature without a voice. It does, however, utter a shrill squeak which is so highly pitched that many human ears are incapable of perceiving it. On the other hand, the Bat has similar deficiencies; and it has been proved that low notes, however loud, make no impression on the Bat, though a sharp clicking sound or the tearing of paper will alarm him at once.

Our Bats are all nocturnal in their habits, though a few indulge in occasional flights by day. Most of them have definite hours for flight, the time depending upon the flight period of the insects they prey upon particularly. They retire for the day into dark situations, such as hollow trees, caves, outhouses, or under roofs. In these sleeping places great numbers often congregate, and several species may be represented. During bad weather—when, of course, their insect prey also remains under cover—they do not leave their daytime shelter. When asleep their body temperature falls considerably. In harmony with this nocturnal habit we find that our Bats are usually dull coloured—some tint of brown with the underside lighter than the upper.

All the British species hibernate, and before the beginning of this period they develop a good deal of fat to carry them through it. On any day in the winter when there is any considerable rise of temperature they wake at once and look around for insects that have been aroused by the same means. The larger



Pl. 14.

Greater Horse-shoe Bat (*Rhinolophus ferrumequinum*)
asleep in cave.



Pl. 15.

Greater Horse-shoe Bat.
head enlarged, to show remarkable nose-leaf.





Pl. 17.

Lesser Horse-shoe Bat.
Rhinolophus hipposideros.

D 33.

kinds usually eat their food as they fly, but the smaller Bats rest for a few moments for this purpose. The web between the legs and tail ("interfemoral pouch") is mostly used to hold their prey whilst it is being eaten. It also serves to receive the newly born young.

The young Bat is born blind, but not quite naked. It at once clings to its mother's fur by means of its claws, and by its teeth to her nipple. Nursing mothers appear to form colonies apart from the others. The growth of the young Bat is rapid and it is soon fully covered with fur. Before it is a fortnight old it is able to leave its mother temporarily, but it does not lead an independent life until it is about two months old. Nothing certain is known about the age to which a Bat attains, but it appears to be about four years.

Until the present century there was an astonishing lack of knowledge of the life-histories of our native species; but a small but enthusiastic band of observers have in recent years done much to make good the deficiency. In this connection the work of Messrs. Alcock, Coward, Moffat, Oldham, Tomes and Whitaker calls for acknowledgment. They have hunted far and wide, exploring the sleeping places and hibernacula, in woods, caves, roofs and belfries, and have established—among other facts—that our Bats are more numerous in the south, becoming scarcer as we go west, and that there are few species represented in the fauna of Scotland. Most of the species appear to be common in some one or more localities, even if rare elsewhere; and the physical features of a district have a striking influence on their local abundance or scarcity, certain species being more discriminative in this respect than others. The presence of woods, water, and caves appears to be the most favourable condition governing their comparative plentifulness or scarcity.

The Bats were known generically in Anglo-Saxon times as Flittermouse and Reremouse, and these names may be met with still in certain localities; but to the general public the Bat is

still a Bat without distinction of species. Although there are twelve distinct kinds that breed in the British Isles, for each of which the naturalist has had to invent an English as well as an international name, not one of these has got into ordinary use ; so that it is impossible to get any precise information from those whose occupation gives them opportunities for observation.

Larger Horse-shoe Bat (*Rhinolophus ferrum-equinum*, Schreber).

We have two Horse-shoe Bats, distinguished as Larger and Lesser, and they are regarded as the lowest organised of our Bats. Their distinguishing feature as a genus is the absence of the tragus from the ear, and the presence of a leaf-like outgrowth of naked skin on the muzzle around the nostrils. The broad forepart of this forms the horse-shoe, a protruding central portion behind the nostrils is known as the sella, and behind it an erect tapering portion is the lancet. There can be little doubt that this extraordinary expansion is no mere ornament, but a sense organ which enables these Bats to execute their marvellous flight through narrow passages. They are able even to distinguish invisible obstacles like glass, and they fly low down among bushes and herbage where they are far more likely to collide than in the upper air. In these respects their motions are different from those of the other Bats.

The Larger Horse-shoe Bat is a large and rather heavily built Bat whose proportions are only slightly exceeded by the Noctule (page 46), our largest species. The combined length of head and body is about two and a half inches, and of the tail an inch and a quarter. The forearm is two inches or more, and the expansion of the wings covers more than thirteen inches. The large ears are about half an inch broad, narrowing abruptly to the sharp recurved tip ; when laid forward over the face they reach slightly beyond the tip of the muzzle. The lower



Pl. 18.

Whiskered Bat
Asleep on roof timbers.

D 34.



Red-grey Bat,
Myotis matterii

portion of the broad wing membrane is attached to the ankle and the tail almost to the tip of the latter. The colour of the fur above is reddish grey ; on the underside pale grey. Its cry is a sparrow-like chirp.

The mouth has a straight broad opening below the swollen muzzle with its stiff moustache. The large canine teeth are very conspicuous in contrast with the small incisors. The dental formula for this and the next species is : $i \frac{1}{2}, c \frac{1}{1}, p \frac{2}{3}, m \frac{3}{3}$ = 32.

As already indicated, the flight of this Bat is usually low, and it alights to consume its prey, which it presses against the wing membrane, the interfemoral pouch not being large enough for the purpose. Its food consists chiefly of the larger beetles, such as cockchafers and dor-beetles, the quick-running ground-beetle *Pterostichus*, moths, flies, bees, and caddis-flies. It appears to be a thirsty creature, and may be seen lapping water. It takes its daytime sleep in caves, dark buildings, lofts and roofs. It may hang singly or crowd into crevices. Mr. Coward found it in the Cheddar caves hanging in bunches. Their overhead resorts are revealed by heaps of excrement below. Their natural resting attitude is hanging by the feet head downwards. They cannot walk on a flat surface, and before alighting on a vertical one they turn a somersault in the air to get the proper position. Their senses are so acute that Mr. Chas. Oldham says : "Even when sunk in winter sleep they appreciate a man's approach. The eyes are, of course, then shrouded by the wings, and the sense of danger must be conveyed to them either by hearing, smell, or, as seems to be most probable, by the exercise of their extraordinary tactile sense, which enables them to actually feel the approaching danger."

There is but one young at a birth, which occurs at the end of June or in July. Its eyes are closed, and the underside is quite naked and the skin purple. The eyes open about the tenth day.

The Larger Horse-shoe Bat has an extensive distribution. From England it is found through Central Europe and the Mediterranean region, through the Himalayas to China and southern Japan. In our own country it is found chiefly in the South-west of England, South and West Wales, but does not occur in either Scotland or Ireland. The presence or absence of caves suitable for a winter retreat appears to have some bearing upon its distribution.

Lesser Horse-shoe Bat (*Rhinolophus hipposideros*,
Bechstein).

The Lesser Horse-shoe Bat is much smaller and more delicately built than the species last described. The nose-leaf has a narrower outline and its sella is more wedge-shaped ; the lancet slender with a wedge-shaped tip. The expanse of wings is less than ten inches, and the length of the forearm is only an inch and a half. The colour is much the same as in the larger species, but somewhat darker above and more yellow below. Its habits are similar also, but, naturally, it does not hunt such large beetles, nor does it fly so low. It has a more fluttering flight with intervals of gliding. Its "tchek-tchek" cry is of lower pitch than in most Bats, and Oldham compares it to a diminutive of the alarm-note of the Greater Spotted Woodpecker.

The single young one is born somewhat later than in the last species : it is born like the other with a thin coat of downy hair on the upper side only.

Males, apparently, are more numerous than females.

The species appears to be more abundant in localities where there are caves which provide it with the equable temperature it requires in hibernation. It is most susceptible to wind, and will frequently remain inactive in its shelter because there is wind outside. Even tame individuals exhibit a strong





Pl. 21.

Daubenton's Bat.
Myotis daubentonii

D 37.

desire to get into the most retired corners and crevices. The first recorded British example was taken in a cavity over a baker's oven to which it had obtained access through a small fissure.

It may be considered a common species in the South of England from Kent to Cornwall, and more sparingly to Wales. It is unknown in East Anglia, rare in the Midlands, and its northward range terminates at Ripon. In Ireland it occurs in the West only, in some parts of which it is the commonest species. Its wider distribution includes Central Europe, Mediterranean, to Gilgit ; northward in Europe to the Baltic.

Whiskered Bat (*Myotis mystacinus*, Kuhl).

The small and usually solitary Whiskered Bat was formerly considered to be a rare species, but it turns out that the naturalists of last century frequently confused it with the Common Bat—the Pipistrelle—which, however, is smaller and has a broader muzzle. The head and body measure about an inch and a half, and the tail the same length. The wings are narrow, but long, and have an expanse of nine inches.

The soft, long fur of the upper parts is light yellowish brown in colour ; lighter, almost dirty white below. It extends but slightly on the wing membrane, and there is little of it on the long, slender ear, whose outer margin is deeply notched, and the straight, tapering tragus half the length of the shell of the ear. The hinder margin of the brownish black wing membrane is continued to the base of the toes, and the spur (*calcar*) reaches halfway from the ankle to the long tail. Owing to the length of the fur on the face the small eyes are almost hidden and the face appears to be very short. There is a bristly moustache on the upper lip which has suggested its trivial and scientific names.

Though reputed to be of solitary disposition—and it usually

enjoys its daytime rest apart from its kin—it has been taken in numbers on several occasions. It makes its appearance early in the evening, flying low along hedgerows, plantations, and cliffs, its method of hunting being not to chase flying insects in the air but to pick off such as have settled on leaves and twigs. It may also be seen at times flying in the daytime. It has a fondness for the neighbourhood of woods and water, where it finds many flies, beetles, and moths in flight. It is quite silent on the wing.

Mr. Oldham describes the flight of the Whiskered Bat as “slow, steady, and silent—I have never heard this species squeak on the wing. Individuals did not appear to wander far, but confined their attentions to single pools or short stretches of the stream, where they flitted about the alder-bushes or threaded their way with marvellous precision through the lower branches of the sycamore trees. I never saw one rise to a greater height than twenty feet, and often they flew within a few inches of the ground or skimmed the surface of a pool for a yard or two, only to rise again to resume their flight around the alders.”

It is not very particular where it takes its daytime sleep. Any sort of shelter will do, whether it be a hollow tree or under a piece of loose bark, a hole in the wall, a roof, or behind window shutters. Its hibernation is passed by preference in a cave, whence it emerges for a flight whenever the weather is fine. In spite of its customary silence, it can produce a feeble squeak.

On the wing it is not easily distinguished from the Pipistrelle, which is so similar in size; but the noisiness of the Pipistrelle compared with the silence of the Whiskered Bat is the best guide.

The solitary young one is born in June or July.

It is widely distributed throughout England, with the exception of East Anglia. In Yorkshire it has been found at an

Pl. 22.



Daubenton's Bat.

Typical alder-sheltered resort of this species.

Pl. 38.



Common Bat

Vesperugo communis (L.)

elevation of 1400 feet. It appears to be common in Wales and Ireland, but rare in Scotland. It occurs all over Europe where there are trees, and extends eastwards to Asia. It is the smallest member of its genus.

We have three other representatives of the genus *Myotis*, which is probably the largest as it is the most widely distributed of all the genera of Bats. They are all of slender, delicate form, which is seen most clearly in the shape of the skull, the muzzle, the ear and its tragus. They agree also in having thirty-eight teeth—six more than in the Horse-shoe Bat. The dental formula of all the members of the genus is: $i \frac{2}{3}, c \frac{1}{1}, p \frac{3}{3}, m \frac{2}{3} = 38$.

Red-grey Bat (*Myotis nattereri*, Kuhl).

The Red-grey or Natterer's Bat is somewhat larger than the Whiskered Bat, the head and body measuring about an inch and three-quarters, but the tail is relatively shorter, being only an inch and a half. It has the longest wings of our species of *Myotis*, their expanse being equal to eleven inches and a quarter.

The long, soft and dense fur is of a greyish-brown colour above and whitish on the underside. The wing membranes are dusky. It has a small head, with a narrow muzzle which is naked at the tip and slightly overhangs the lower jaw. The face is so densely covered with fur that the small eyes are hidden. There is also a moustache, and above the lips on each side is a prominent gland. The large oval ear is notched on the outer margin above the middle, and the long slender tragus is more than half the length of the ear, ending in a long, very slender point. The wing membrane extends to the base of the outer toe, and the interfemoral membrane is distinctly fringed with stiff hairs along its lower edge. The tail, which is carried extended behind, is slightly less than the head and body in length.

The Red-grey Bat shares the Whiskered Bat's partiality for wooded districts, where it may often be seen in numbers, even before sunset. Unlike the last-named species it is both sociable and gregarious, and its daytime retreat in holes in walls, hollow trees, and caverns, is shared with Bats of its own and other species. It flies low, with a slow, steady flight, and often picks flies and small moths off leaves and twigs. When so engaged like the Whiskered Bat it may be known from it by its noisy chirping. It will turn somersaults in the air in order to alight by clinging with its feet.

The solitary young one is born towards the end of June.

It does not appear to be a generally distributed species even in the South of England. Its range extends from Cornwall and the Isle of Wight to Durham and Norfolk. It also occurs in Wales and various parts of Ireland. In Scotland it has been reported from Argyll, Midlothian, and Montrose. It is a native of Central and Southern Europe, extending north to the south of Sweden.

Bechstein's Bat (*Myotis bechsteinii*, Kuhl).

Bechstein's Bat has a general resemblance to the Red-grey Bat, but is slightly larger, with ears almost twice the breadth of those of that species, and the feet relatively as well as actually larger. Though the skull is larger, it is actually narrower than in that species. The thin ears are relatively larger than those of any European Bat, except the Long-eared Bat, where, however, they are of quite different shape and are connected by their lower margins, whilst here their bases are widely apart. The form of the ear is like that of the Whiskered Bat; so is the tragus, and the shape of the wings.

It is covered with soft, woolly fur, which is a greyish-brown on the upper parts and buff-grey below. The membranes are dark brown; that of the wing arises from the base of the

toes, and that of the interfemoral leaves the last joint of the tail free.

The combined length of head and body is about two inches : of the tail an inch and a half. The ears are about three-quarters of an inch in length and half an inch wide ; the tragus half the length of the ear. The expanse of the wings is ten inches. The single young is born about midsummer.

Bechstein's is the rarest of British bats, and so far has been recorded only from the South of England, the localities being the New Forest, Isle of Wight, Sussex, Berkshire, and Oxfordshire. Our knowledge of its habits is derived chiefly from the Continent, where it flies about woods, orchards, and the neighbourhood of dwellings, coming out from its retreat late in the evening and flying slowly and low over lanes and woodland roads, but only in calm weather. It is restricted to Central and Southern Europe.

Daubenton's Bat (*Myotis daubentonii*, Kuhl).

Daubenton's or the Water Bat was formerly considered one of our rarest Bats, but is known now to be one of the most widely distributed and plentiful species. It had probably been mistaken for the Common Bat or Pipistrelle to which it comes near in point of size, though its habits are different. It keeps close to the water, especially to some alder-sheltered pool in the river where there are plenty of caddis-flies and other insects. There from an hour before sunset it flies slowly in circles, frequently dipping its muzzle into the water to pick up surface insects. In such places the evening fly-fisher sometimes finds this Bat caught on his hook. It appears to be on the wing all night. It was probably to this Bat that Gilbert White referred in his eleventh letter to Pennant, when he said : "As I was going, some years ago, pretty late, in a boat from Richmond to Sunbury, on a warm summer's evening, I think I saw

myriads of Bats between the two places ; the air swarmed with them all along the Thames, so that hundreds were in sight at a time." This was long before it had been distinguished as a distinct species, and when it would probably have been regarded as the Common Bat.

It is clothed with short, dense fur, of a grizzled warm brown colour on the upper parts, and lighter brown or buffy grey, sometimes so pale as to show a distinct line of separation along the sides from the angle of the lips to the thigh. The face is dusky, and the ears and wing membrane are of a reddish dusky tint. The interfemoral membrane is whitish below, and there are whitish hairs on the toes. The membrane arises from the middle of the foot.

In size it is a little larger than the Whiskered Bat and the Common Bat, but smaller than Leisler's Bat. The head and body measure about two inches, the tail an inch and a quarter, the ear half an inch ; the wing expanse is about nine inches. The fore-leg and foot are conspicuously large. The ear has a rounded tip, and a shallow concavity on the upper part of the hind margin ; the lance-shaped tragus is about half the length of the ear. The spur or calcar of the foot extends three-fourths of the distance between the foot and the tail. The last two joints of the latter usually extend beyond the membrane.

For its daytime rest it retires to crevices in trees, walls, caves or roofs, often in numbers, but its resorts have not the evil smell that such places frequently give off. It has a low soft chirp, less shrill than the cry of the Common Bat. In hibernation—which extends from the end of September to about the middle of April—it is no longer sociable, but hangs alone in some dark cave.

There is a single young one, born in June or July.

Its range extends from Ireland to Asia, and from the Mediterranean to central Norway.



Pl. 4.

Serotine Bat,
Myotis myotis.



P. 25.

Common Bat.
alighting on branch.

P. 43.

Common Bat (*Vespertilio pipistrellus*, Schreber)

The Common Bat is in a general sense familiar to everybody, for it may be seen in the evenings flying everywhere, even in the streets of crowded cities. Its British distribution extends from the South of England to Scotland and the Hebrides and westward to Ireland. Its wider range includes Europe and parts of Asia. It is the smallest of the British Bats.

In spite of its small size—the head and body measure little more than an inch and a half—the Common Bat is of robust build, and it has a wing expanse of over eight inches. It has a flat broad head with a blunt muzzle and wide mouth. The short, broad ears are somewhat triangular with blunt tips. The erect, slightly incurved tragus has a rounded tip which does not reach quite to half the height of the ear. There are glandular swellings on the muzzle between the nostril and the small, but rather prominent eye. The tail is little over an inch in length, and the legs also are short. The last joint of the tail is free from the membrane and prehensile, and the Bat makes use of it as a support in crawling up or down. The spur reaches more than half way to the tail. The narrow wing is attached to the middle of the sole of the foot.

The somewhat silky fur is a reddish-brown on the upper parts, slightly paler beneath. The wing membrane and the ears are blackish.

It is a very active Bat, flying over farmyards and gardens and about houses, frequently uttering its shrill little squeak as it snaps up the flies and small beetles, pouching and eating them without alighting. It continues its flight all through the night, and has a longer period of activity than any other species, for it leaves its hibernaculum in March and does not retire until winter has begun. Even then, a moderately high mid-day temperature is sufficient to awaken it and bring it out for an hour's hunt. It is this habit that accounts for the letters in the

daily papers from City gentlemen who report the presence of a Bat flying along Cornhill or Cheapside early in January.

It is not particular in regard to its sleeping place, and is frequently found under roofs, behind rainwater pipes and gutters, or in any crevices between woodwork and brickwork in buildings. Any regular dormitory acquires a very fetid odour from its use.

The dental formula of the Common Bat is: $i \frac{2}{3}, c \frac{1}{1}, p \frac{2}{2}, m \frac{3}{3}$ = 34. Schreber's name of *Vespertilio pipistrellus* was bestowed in 1774 and is the oldest name; in the British Museum Catalogue it is *Pipistrellus pipistrellus*, a combination invented by Miller in 1897.

Serotine (*Vespertilio serotinus*, Schreber).

The Serotine and the Noctule are our two largest Bats, and in the early records they were very much confused. Though similar in size, they may be known apart by the shape of the ear; in the present species oval-triangular with the tips rounded. The fur is also of a darker brown, and there are other points of difference, such as the possession of two additional teeth by the Noctule. But for a few records of its occurrence in Essex, it might be said to be restricted in Britain to that portion of England bounded by the river Thames and the English Channel. A few examples have been taken in Cornwall, and other counties in which it is found are Surrey, Hampshire, Sussex, and Kent. It occurs throughout the Isle of Wight—where it is known as Rattle-mouse—but Kent is its British metropolis, where it is the commonest Bat. It extends through Central and South Europe, from Denmark to the Mediterranean and eastward into Asia.

It has a somewhat swollen face with little hair on the front portion, save for a moustache on the upper lip; but owing to the dark skin of the face the lack of fur is not very noticeable.



Pl. 26.

D 44

Great Bat

showing use of tail as additional foot



Pl. 27.

Serotine Bat.

Myotis serotinus (L.)

The dark brown fur of the upper parts is soft and dense; behind the shoulders the hairs have buffy tips. On the under-side the fur is somewhat lighter. There is little extension of fur on the wing, except a line of down on the under surface of the forearm. The membrane is attached to the base of the toes. The head and body measure about three inches, and the tail slightly exceeds two inches, the last joint being quite free of the membrane. The expanse of the wings is fourteen and a half inches. There are prominent glandular swellings on the muzzle. The ear is about three-quarters of an inch long; the short tragus—less than half the length of ear—has a straight front border and a curved hind border, with rounded tip. The canines and the inner incisors of the upper jaw are noticeably large and strong. Dental formula : $i \frac{2}{3}, c \frac{1}{1}, p \frac{1}{2}, m \frac{3}{3} = 32$.

The Serotine makes its appearance in public about sunset, apparently retiring early and flying again in the early morning. It frequents glades in woods, and preys upon beetles and moths. In May and June large numbers of cockchafers fall victims to it, and in July and August in Kent and Sussex it plays havoc with the local Brown-tail Moth. In the early part of its season it flies at a low height, but later it prefers an altitude between thirty and forty feet, from which, however, it frequently descends to the ground. The change is, no doubt, connected with the seasonal succession of insects with different habits. It is a sociable species, and when it retires to holes or roofs for its daytime rest it is usually in company. Its hibernation begins at the end of October. Its voice is a squeak.

The Parti-coloured Bat (*Vespertilio murinus*, Linn.) is sometimes enumerated among British Bats, but on the strength of only two specimens captured in this country, in the "thirties" of last century. As one of these was taken at Plymouth and the other at Yarmouth, it is reasonable to suppose that they

were mere stragglers which had reached our shores on board ship. Had they occurred as residents their distinctive coloration—dark brown upperside mottled with yellow-brown and whitish underside—and large size, would have established their identity at once.

Great Bat (*Nyctalus noctula*, Schreber).

Though similar to the Serotine in size and to the Pipistrelle in form, the Great Bat or Noctule was recognised as a distinct species long ago. We might with great fitness call this White's Bat, for it was the Selborne naturalist who first called attention to it as a native species, under the name of *altivolans*, suggested by its high flight. Schreber, however, had some years previously named it *noctula*, basing his description upon a French specimen. White refers to it several times, and in his xxxvith letter to Pennant gives particulars which the latter included in his "British Zoology." Part of White's description is worth quoting. He says: "In the extent of their wings they measured fourteen inches and a half; and four inches and a half from the nose to the tip of the tail; their heads were large, their nostrils bilobated, their shoulders broad and muscular; and their whole bodies fleshy and plump. Nothing could be more sleek than their fur, which was of a bright chestnut colour. . . . They weighed each, when entire, full one ounce and one drachm. Within the ear there was somewhat of a peculiar structure that I did not understand perfectly! [? tragus] but refer it to the observation of the curious anatomist. These creatures sent forth a very rancid and offensive smell."

To add to White's description, it may be said that the general form is robust and heavy, the forearm massive, the wing long and slender, its narrowness being due to the shortness of the fifth finger. The lower leg is short and thick and the foot broad and powerful. The muzzle is broad and has a glandular



Leisler's Bat.

Myotis leisleri.



Pl. 29.

Great Bat
alighting after day-time flight.

D 47.

swelling between eye and nostril. The nostrils project forward and outward and there is a distinct concavity between the two crescent-shaped orifices. The ear is short—when flattened it is broader than long—with the front border rounded to the tip ; its inner surface covered with short hairs. The ears are far apart. There is a very short, downy, bow-shaped tragus, broader above than below. The long, soft, golden-brown fur is abundant, and extends over the face and a short distance over the wing ; it is paler and duller on the lower parts. On the underside there is a narrow band of fur below the arm bones. The last joint of the tail is free. The membrane and ears are blackish.

The dentition is : $i \frac{2}{3}, c \frac{1}{1}, p \frac{2}{2}, m \frac{3}{3} = 34$.

The Great Bat, as one would expect from the shape of the wings, has a quick, dashing flight reminding one of that of the Swifts, with which, indeed, it may be seen high in the air hawking for the same prey. It often glides down obliquely on expanded wings. It flies at twilight and again at dawn, as well as in the daytime occasionally. It has a shrill, clear, cricket-like voice.

Mr. C. B. Moffat says they “cram themselves to bursting point either once or twice in the twenty-four hours, during a seventy minutes career of mad excitement among the twilight-flying beetles and gnats.” They also take moths and other insects ; but in captivity they have resolutely refused to eat such “warningly coloured” species as the Cinnabar and Magpie moths. It is proved that at one meal they will consume food equal to a fourth of their own weight. When one considers the lightness of insects the amount of good these purely insectivorous creatures effect is obvious.

Their resorts are in hollow trees and under the eaves of buildings, where numbers may associate together, especially in hibernation. Their presence is often indicated by thick layers of excrement.

The Great Bat flies all through the year with the exception of January and the latter part of December. Pied and almost black variations from the normal colouring have been recorded.

The sexes are said to separate into distinct colonies in the summer: the females retiring to trees. The single young is born naked and blind towards the end of June. When they get their fur they are much darker than the adults.

Although the Great Bat is generally distributed as far north as Yorkshire, Durham, and the Lake District, it is common only in the South of England, from Norfolk to Cornwall, but is rare in the Isle of Wight. It is not recorded from Ireland. Formerly, it was not considered a native of Scotland, but in recent years several examples have been captured there. It is found throughout the greater part of Europe and adjacent parts of Asia.

Leisler's Bat (*Nyctalus leisleri*, Kuhl).

It is not necessary to give a detailed description of Leisler's or the Hairy-winged Bat, for it is a miniature edition of the Great Bat in a darker binding. The length of the head and body is two and a half inches and of the tail an inch and a half. The wing expanse is thirteen inches and a quarter. The fur on the upper parts is a darker brown than that of the Great Bat, but it is lighter on the under parts. The skull is only half the size of that species, and the entire build is lighter and less massive. Owing to this difference in size it is not so likely to be mistaken on the wing for the Great Bat as for the Common Bat. It is without the strong odour of the Great Bat. It agrees with the latter in its high flight, but its movements are not so swift and are more zig-zag.

It is one of the rarest of our Bats, and like the Great Bat a woodland species, making its dormitory preferably high up in a decayed oak, but also in the roofs and crevices of buildings.



Pl. 30.

Leisler's Bat
asleep on roof masonry.

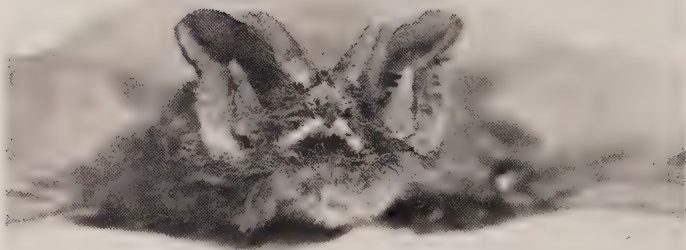
D 48.



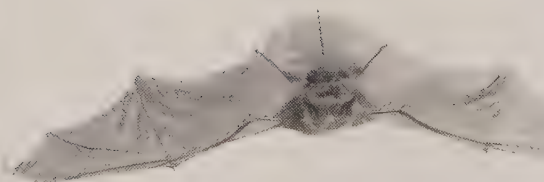


Pl. 32.

Long-eared Bat.
Ears uncurling after sleep.



Face, showing distinctive ear and tragus.



Its period of activity begins about the third week in April and lasts until near the end of September, when it goes into hibernation, but a little mild weather in winter will wake it up and bring it out for a flight. According to the observations of Mr. C. B. Moffat it flies for about a hundred minutes just after sunset, and for a similar period just before sunrise. Its food consists of flies, beetles, and moths. Dr. Alcock, who has brought this Bat down by shooting it an hour after sunset, found it so crammed with food that it did not appear physically possible for it to feed longer.

The distribution of Leisler's Bat does not agree at all with that of its near ally, the Great Bat. It has been obtained chiefly in the Valley of the Avon (Warwickshire); also in Yorkshire, Cheshire, and Norfolk. It does not appear to occur in Scotland; but it is reported as abundant in several parts of Ireland. It is a purely European species, occurring only from Central Europe westward.

Long-eared Bat (*Plecotus auritus*, Linn.).

The Long-eared is probably the best-known of our Bats owing to the very distinctive character afforded by the huge ears, which are as long as the forearm and longer than the body. In addition, it is one of the commonest and most widely distributed of our Bats, and likely to be met with anywhere in the British Islands. It is, however, rarer in the North of Scotland than elsewhere. It is found nearly all over Europe.

The large and mobile ears give this Bat an appearance of size not justified by its small and delicate build. The head and body combined measure less than two inches, whilst the tail is only a fraction less than that measurement. The fact that no other European Bat has such an equipment renders a detailed description superfluous, for the ears at once distinguish this from all the other species. These ears have their bases joined

across the forehead. Their form is a long oval with rounded tip. Except for fringes on the folds they are hairless. They are semi-transparent and have transverse folds. The tapering tragus is nearly half as long as the ear, and might be mistaken for it when the Bat hangs asleep; for then the ears are carefully folded and tucked away in the wing whilst the tragus sticks out beyond the inanimate-looking bundle. Sometimes, when awake, one ear is held at a different angle from the other; but in flight both ears are directed forward. Often, when it has caught an insect, the Long-eared Bat will come to the ground to eat it.

The soft, silky, brown fur is long and thick, especially on the shoulders, but does not extend far upon the wings. On the under parts it pales to yellowish or dirty white. The wings are both long and broad, and their expanse in flight is about ten inches. The long tail when folded forwards can touch the top of the head; its tip is slightly free from the interfemoral membrane, and when the Bat hooks itself up head downwards for sleep it serves as a third foot.

The Long-eared Bat is found chiefly among trees, though it frequently comes into open windows at night when its hunting is over. It flies among the branches of trees and examines the foliage for insects of all kinds. In early spring, when the willows are in bloom and attracting swarms of insects, the Long-eared Bat is there also: fresh from hibernation and with a keen appetite. He hovers like a hawk over a favourable tree, and swoops down upon his selected prey. He appears in the evening usually about half an hour after the sun has departed, and apparently feeds during the greater part of the night; occasionally he is active in daylight. He appears to be at least partially migratory, for it has been observed that in summer a swarm will appear in a district where they are not noticeable as a rule, and after staying a few weeks disappear.

The single young one is born in June or July.

They are often found hibernating in clusters under house-roofs ; but solitary individuals are also found in hollow trees and similar situations. Should the thermometer register 46° F. or more at any time during the winter, the Long-eared Bat awakes and makes a foraging flight—calling attention to his presence by his acute, shrill cry.

The dental formula is: $i \frac{2}{3}, c \frac{1}{1}, p \frac{2}{3}, m \frac{3}{3} = 36$.

Barbastelle (*Barbastella barbastellus*, Schreber).

One feels inclined to apologise for the poverty of language displayed in the heading above ; though no one accepts responsibility for it—the fault lies with the Law of Priority. A strong point in the Linnean System of nomenclature was its binomial character—there were two words only in the name of every animal and plant, the first of the two indicating the genus in which it was grouped, and the second peculiar to the species. In recent years the extension of our knowledge of the world's fauna has led to the breaking up of many of the older genera and a regrouping of the species. In some cases the species name has been adopted to denote a new genus, and then the Law of Priority steps in and says the oldest species name must be retained, so that instead of a binomial we get a mere duplication. When this happens—as above—to be essentially the same as the only “popular” name the species has ever had the result is ludicrous.

Daubenton, who first described it (1759), called it the Bearded Bat (La Barbastelle) owing to tufts of black bristles on the glandular swellings on the muzzle. It is of slender form with long legs and small feet. The irregularly four-sided ears are relatively large, as broad as long, and united by their bases just behind the muzzle. The outer border has a deep notch ; the lance-shaped tragus is half the length of the ear. The nostrils open in a naked depression.

The long, soft fur is a very dark brown, but many of the hairs on the upper surface have pale tips which produce a frosted appearance; on the lower surface such light tips are more numerous, and are specially evident along the middle line of the abdomen. The wing, ear, nose, and foot are dusky, appearing lighter than the furred regions.

The head and body measure about two inches, and the tail an inch and three-quarters. The expanse of wings is about ten and a third inches. This and the Long-eared Bat are the only British species whose ears connect; and the form of the ear in each is so distinct that there is no danger of confusing them. It is both solitary and silent in flight, which begins early in the evening, often in daylight; it holds its feet far apart and the tail decurved. In fine weather it flies high. During its diurnal rest it has been found in various retreats, often in company: under thatch of a shed, between the rafters and tiles of out-houses, behind a cottage shutter, in the crevices of walls and trees. Its voice is a metallic squeak or a buzz.

It has one premolar less on each side than the Long-eared Bat, so that its dental formula stands thus: $i \frac{2}{3}, c \frac{1}{1}, p \frac{2}{2}, m \frac{3}{3} = 34$.

As a British Bat, the Barbastelle is found chiefly in the South of England, though it has been recorded from all the English counties between the Severn and the Wash; also Lincoln, Cheshire, and Cumberland (Carlisle). It appears to be absent from Scotland, Ireland, and the Isle of Man.

Fox (*Vulpes canis*, Linn.).

It is safe to say that, except in the wildest and most remote corners of our island, the Fox would have been placed long ago in the list of extinct British mammals, but for its careful preservation by the various "hunts." In recent times—that is since fox-hunting became a fashionable sport—the poultry and sheep-raising agriculturist has had to bear heavy losses in order





Pl. 35.

E 53.

Fox cub
taking a peep at the outside world.

that the local pack of fox-hounds may have its well-conditioned quarry at the proper season. As far back as the reign of Elizabeth an Act of Parliament was passed for the protection of grain, which incidentally provided for the payment of "xijd" for the head of every Fox or Gray that might be brought in to the officers appointed to receive them. To-day, outside the hunt areas, the killing of a Fox is considered a meritorious act, particularly in the northern mountain districts ; in Cornwall, we have seen a loafer carrying a dead Fox around the villages and receiving pence from the grateful owners of domestic poultry.

The head and body of the Fox measures usually a trifle over two feet in length, and the bushy, white-tipped tail adds at least another foot to his total length when running ; but examples have been recorded greatly exceeding these measurements. He stands only about fourteen inches high at the shoulder. The beautiful fur is russet or red-brown above and white on the under parts. The front of the limbs and the back of the ears are black. The sharp-pointed long muzzle, the erect ears, and the quick movements of the eye with its elliptical pupil combine to give him an alert, cunning appearance, which so impressed the ancient writers that they invented many stories of his astuteness. The Foxes ("Tods") of Scotland, although of the same species, have usually greyer fur than that of the English Fox. The Fox is an ancient Briton, and he was here at a period long anterior to the Mammoth's days.

The habits of the Fox are nocturnal, and save at the breeding season he leads a solitary life. The day is spent in an "earth"—a burrow underground, rarely made by himself, usually acquired from Badger or Rabbit ; in the former case he has probably taken up quarters in the entrance to a Badger's earth and rendered it uninhabitable to the more cleanly beast by permeating it with the secretion from glands under the tail. In the case of the Rabbit-burrow the Fox gets undisputed possession by eating out those who constructed it. The Fox then

stops all the exits except one, leaving that if possible that opens in a bramble thicket or the dense undergrowth of bracken on a hillside. From this stronghold he issues at dusk, and trots at a light easy pace along his accustomed trails, keeping a watchful eye for rabbit, hare, pheasant, partridge, hedgehog, squirrel, vole, frog—even snails and beetles. He sometimes takes to the seashore in quest of fish, crabs, and mussels. On winter nights he will prowl around the farms, looking for a hen-house whose door has not been properly secured ; or for a fowl that is sleeping out in the copse. Sometimes a lamb is the victim, and in the



Skeleton of Fox.

mountain districts hunger will goad him to attack one of the small mountain sheep, especially if the vixen is hunting with him. If cornered he proves a hard fighter, and snaps like a wolf.

At night in January the scream of the vixen or she-fox, may be heard in appropriate places, and the yelping bark of the dog fox in answer to her invitation. About April the Vixen produces her litter of about four blind whelps. She is a model mother, unremitting in attention to their wants and education. They are without sight until ten days old. When nearly a month old



Pl. 36.

Badger's Front-door.

E 54.

The deep entrance slope connects with underground galleries.



Pl. 37.

Badger.
Meles taxus

Pl. 55.

they are taken out one night for exercise, and if suitable cover is found in the wood, or on the moor among the heather, they may not return, though the vixen remains with them and teaches them hunting until the autumn, when the family party breaks up, each member going his or her own way ; though they will not be fully grown until another year has passed. In fox-hunting countries artificial burrows are constructed in suitable places, of earth and stone, of which the expectant-mother vixen will avail herself. These are furnished in order that the cubs may be dug out with ease when they have reached a proper age for the huntsman's purpose.

The Fox is credited with resorting to a species of hypnotism to attain his ends. Seeing a party of rabbits feeding, and knowing that they will bolt to their holes on his approach, he starts rolling about at a safe distance to attract their attention ; then like a kitten he will begin chasing his tail, whilst the silly rabbits gaze, spellbound, on the performance. At it the Fox continues without a pause, as though oblivious to the presence of spectators ; but all the time he is contriving to get nearer, until a sudden straightening of his body enables him to grab the nearest rabbit in his jaws.

The Foxes of the northern hill country are a finer race than those of the southern woodlands. This, of course, is due to the fact that every man's hand is against them, and it is only the individuals of great cunning and superior physique that survive to continue their kind.

Dental formula : $i \frac{3}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{2}{2} = 42$.

Badger (*Meles taxus*, Boddaert).

In the old forestal days of Britain the Badger, Brock, Bawsen or Grey must have been a common beast. Like the Beaver—also a former British beast—he has left indelible marks in place-names, such as Brockham, Brockenhurst, Brockley,

Brockholes, and many more. In the present day, by the majority of people, the Badger would be regarded almost as one of the extinct native fauna, only to be read of in books. But it is very far from being extinct; and the London naturalist who is determined to see it may have his wish gratified with a journey of no more than five and twenty miles, possibly less. It must be remembered, however, that the Badger is even more nocturnal in his habits than the Fox, retiring at dawn to his "set" deep in the earth, where he sleeps until dusk. This underground hollow may be ten feet or more below the surface, and besides the entrance slope it may have several passages and upper galleries, with probably a back door at some distance from the main entrance. In front of this aperture, and partly hiding it, is a mound of earth that was turned out when the excavation was made, and the size of this mound may be taken as an indication of the depth and extent of the habitation. It is no unusual thing for some of the upper passages communicating with the entrance to be tenanted by Foxes and—Rabbits! The proximity of the Badger's "set" may be ascertained sometimes, when rambling through the woods, by coming across a beech or birch tree whose smooth bark is scored vertically, and an idea of the size of the Badger may be obtained by noting the length of these marks. They are caused by the Badger "up-ending" and stretching his limbs to the full extent whilst he cleans and sharpens his claws, as the domestic cat does hers on a table leg. The scores of the Badger cubs may be found there also.

The rough-coated Badger measures from two and a half to three feet long, and stands about one foot at the shoulder. At a little distance he appears to be of a uniform grey colour, but more closely he is seen to be reddish-grey above and black beneath. The body is stout and broad, the muzzle pointed; the ears short, and tail 7 to 8 inches long. The soles of the feet are naked, and the claws of the fore feet are larger than those of

the hind feet. His weight may be anything up to 40 lbs. The Badger is by no means particular as to the nature of his food : he is a general feeder, and most things appear to be to his liking, whether young rabbits, voles, hedgehogs, birds that have dropped from the nest, mice, snakes, lizards, grubs of wasps and humble-bees, for which he will rout out underground nests, and beetles from under bark or among decaying leaves. On the vegetable side he is known to hunt for fleshy roots, to pick up acorns and other fruit, and C. St. John found he had a liking for the bulbs of the Bluebell—that is to say, he frequently found them about the Badger's holes.

The female prepares a special lying-in chamber well furnished with moss and grass, and there in spring or summer the young cubs or "earth-pigs," three or four in number, are born blind and helpless. These are at first a silver-grey colour, but later they become dull brownish-yellow and finally darker blue-grey, when the characteristic black and white stripes appear on the cheeks. The blue-grey tint harmonises with the half-tones of the wood late in the evening, and the strong contrast between the black and white stripes fits in with the lights and shadows of the moonlit wood. The Badger is not a sprinter, and little of his animal food is obtained by running it down. The birds, voles, and rabbits he captures are mostly sickly or wounded, and he has been known to visit regularly, night after night, the ground under a rookery, in order to pick up luckless squabs that have fallen from the nests. He is said to be clever in springing traps without being caught, by the heroic plan of rolling upon them, and then walking off with the bait. His ordinary gait and form suggest the bear ; and for many years naturalists classed him among bears, but his affinities are now known to be with the Otter and the Weasels. He is exceedingly clean in his personal habits, and to prevent defilement of his "set," digs pits in the neighbourhood for offensive waste.

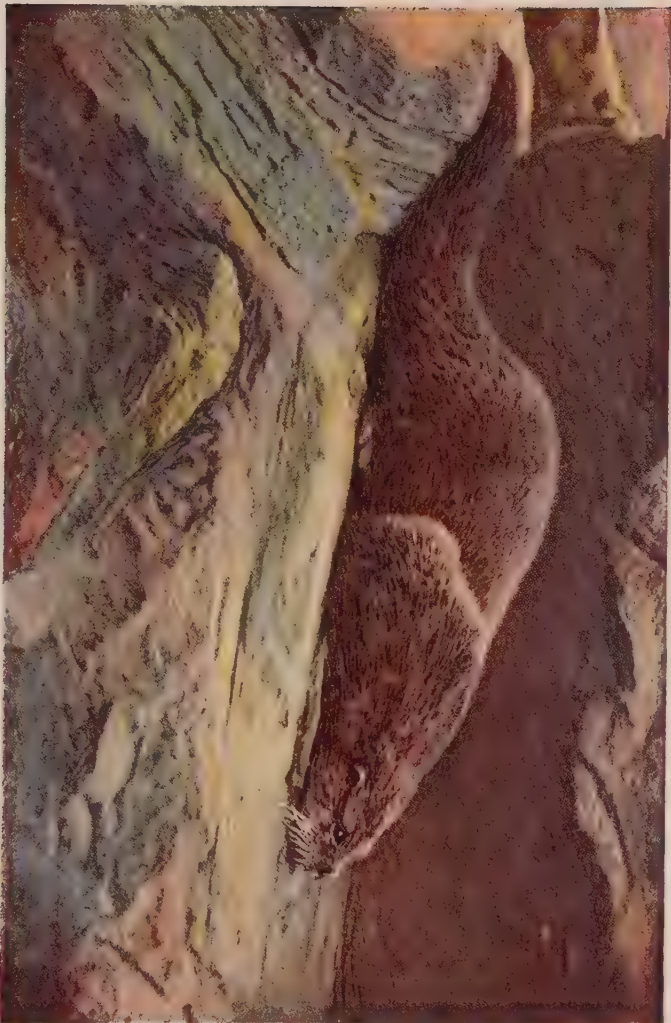
If an ascertained Badger "set" be watched in the late

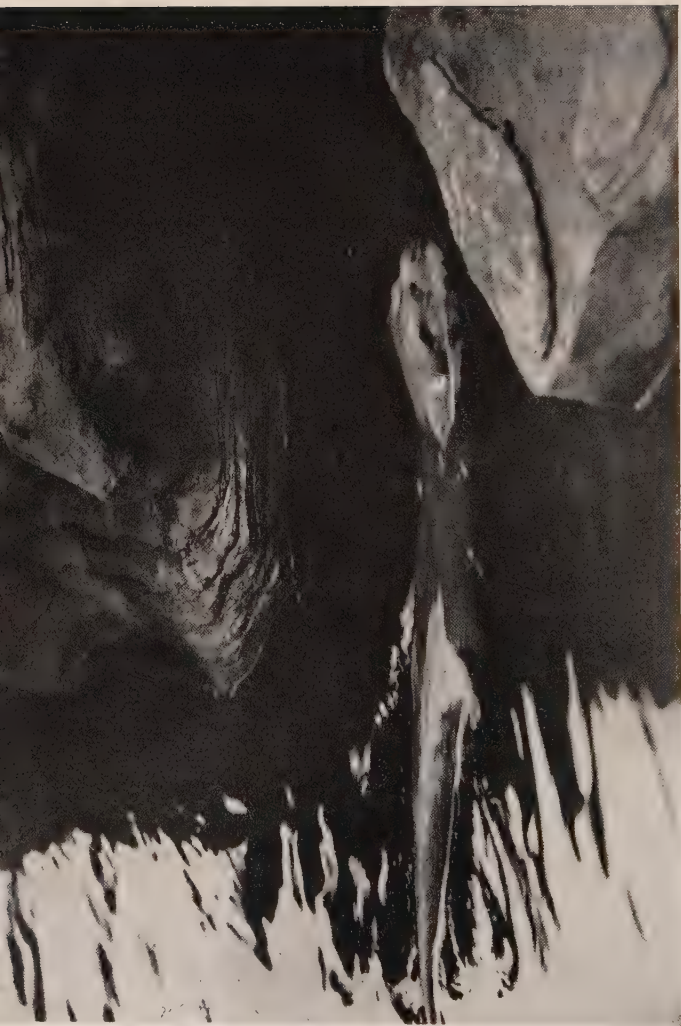
evening, the occupant may be seen to put out his head and, elevating his snout, sniff at the air to ascertain whether it bears any enemy taint. If all is well the Badger emerges, perhaps followed by the cubs ; and they follow the well-worn tracks that their feet have hardened, and hunt for food. St. John says: "Eggs are his delight, and a partridge's nest with seventeen or eighteen eggs must afford him a fine meal, particularly if he can surprise and kill the hen-bird also ; snails and worms which he finds above ground during his nocturnal rambles are likewise included in his bill of fare."

In winter the Badger retires to a specially deep chamber, excavated below the nursery apartment, and prepared in autumn by bedding it with fallen leaves which ferment and keep up a moist warmth. The passages are blocked to keep out unwelcome visitors as well as cold, and when the cold renders food scarce the family retires and settles down to a long sleep. In any short spell of mild weather the Badgers will emerge and see what is to be picked up. The cubs taken young are easily tamed, and in response to kind treatment show a considerable amount of attachment to their owners. Happily for our national reputation, the brutal custom—it was called a "sport"—of badger-baiting has long been a thing of the past. Commending itself, as it did, very strongly to certain elements in our society, it is probable that it may have continued much longer but for the growing difficulty in obtaining victims.

The Badger's dental formula is : $i \frac{2}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{1}{2} = 38$. The minute first premolar in each jaw is frequently shed early, and may be missing from any adult skull examined.

Although the Badger is a distinctly local species, it is widely distributed in Britain and Ireland. In the latter country, where it is common, Badger hams are not an unknown delicacy in rustic larders. In Europe it extends from the south of Sweden to Italy.





Pl. 39.

Otter swimming.

When the rivers are low the Otter retires to sea-caves.

E 59.

Otter (*Lutra vulgaris*, Erxleben).

The Otter is by no means the nearly extinct beast that is commonly imagined ; but he who would see it in a wild state must seek it by night along the banks of remote streams or tarns, where there are alder-holts, or in the neighbourhood of the East Anglian Broads. It may sometimes be found by day, by searching the caves on some remote part of our coast where the cliffs are rocky and the shore strewn with boulders. Even so near the congested haunts of men as the upper Thames, Otters are occasionally trapped.

If one has the good fortune to get a good view of the Otter in such places it will be found to be a very different creature from the specimens in zoological gardens. The long, lithe body, clad in fine smooth fur and ending in the long thick tapering tail, gives it a very graceful appearance in the water ; and, of course, it is a most expert and agile swimmer. The head is broad and flattened from above, the face short, the black eyes small but bright, and the short, rounded ears hairy. The ears are closed when under water. The legs are short and powerful, and all the feet are completely webbed. There are five toes on each, with short pointed claws, those of the hind feet flat and nail-like. The tail is somewhat flattened from the sides, and forms a most efficient rudder. Below its thick base there is a pair of glands which secrete a fetid fluid. The fur is of two kinds : a fine, soft, under-fur of whitish-grey with brown tips, among which are interspersed longer, thicker, and glossy hairs. Water does not penetrate the under-fur. On the upper parts and the outer sides of the limbs, these longer hairs, which have a grey base, have rich brown ends ; but on the cheeks, throat, and under parts they are brownish-grey. At a little distance it appears to be of a uniform dusky brown tint. White, cream-coloured, and spotted examples are on record.

The total length is about four feet, of which about one-third

is tail. The weight of a full-grown male is between 20 lbs. and 25 lbs., but occasionally it exceeds 27 lbs.—Pennant records one of 40 lbs.! The female weighs less than the male by about four pounds. The dental formula is $i \frac{3}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{1}{2} = 36$. The molar teeth have sharp tubercles on the crown.

Where the presence of Otters is suspected, a keen look-out should be kept for their footprints—known as “seal” or “spur” (spoor)—on moist ground, which may help us to find its “holt” or lair, which will probably be a hole in the bank with the entrance under water and overhung by alders and rank herbage. There may also be an alternative way in at the back of the bank above water. Here the Otter rests secluded in the daytime, coiled up like a dog with its tail around its face. The “spraints,” or droppings, are also a good clue for the observer. A short distance in from the mouth of the tunnel, a side-chamber will be found, which is the family midden.

About the time of sunset the Otter wakes up, utters his flute-like whistle, enters the water, and hunts favourite pools in the stream for fish, which it secures by diving below them. These are always brought to the bank to be consumed. The backbone is first bitten through behind the gills; and where fish are large (salmon) and plentiful the Otter often contents himself with a mouthful from the shoulder. At other times he may eat methodically from this point to the tail, which is always left. Apart from the fact that he has to make frequent visits to the surface in order to breathe, he is as much at home in the water as a fish, swimming in circles where the water is deep, and his movements in that element are as graceful as those of the fishes he pursues. Not that his diet is restricted to fish: he is very fond of the river crayfish, and will turn over every stone in his section of the stream in his search for them. He is known also to consume frogs, which he carefully skins before eating them. Occasionally he indulges in wild duck or moorhen; and when he hunts on shore may catch a rabbit



Pl. 40.

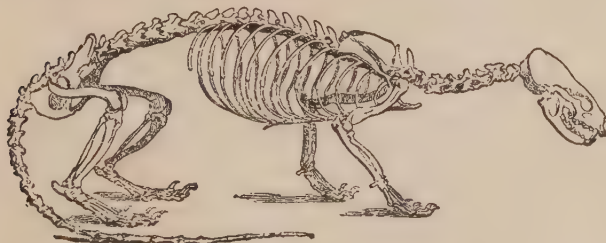
Pine Marten.
Mustela martes.

E 60.



unawares, a rat or a vole. When he goes down stream he floats with the current his forelegs pressed against his sides and only the upper part of his head with eyes, ears, and nostrils exposed.

In summer when the water is low in the streams, he travels across country from pool to pool by night, seeking some estuary or the open coast. Although so obviously adapted for an aquatic life, the Otter can travel with speed on land, and it has been estimated that in one night it will cover about fifteen miles. On arrival at the coast it will seek some bat-haunted cave that has been favoured by its kind for generations, and



Skeleton of the Otter.

will work the shallow waters for flat fish, bass, crabs, and mussels. From here also it will make excursions over a considerable area of neighbouring country by means of the creeks and marshes. In autumn it will return to its favourite stream and feed royally on migrating eels that are on their way to the sea. It does not hibernate. In winter when fishing may be poor, it may be constrained to dig out the mole and the vole from their underground retreats to provide a meal, and is even glad of hibernating insects, either in the larval or pupal condition. It also shows a fondness for the freshwater mussel (*Anodonta cygnea*).

In the rutting season there is a good deal of desperate fighting

between jealous males ; but this business disposed of a nursery nest or "hover" is constructed of rushes and grass, and lined with the soft, purple flower panicles of the great reed. Here, in the winter, the bitch Otter brings forth her two or three blind young. They are already covered with a fine downy fur. Both parents hunt to provide them with food, and in due course they are taken out one night to be taught the way of life in the waters. The partnership of the parents is only temporary, and as soon as the young ones are capable of taking care of themselves, the old dog Otter goes to live by himself. The mother remains with her family until the rutting season returns, when she also departs to find another mate. In Norfolk the nursery is frequently found on the surface, in the great reed-beds.

The chief enemy of the Otter is the river-keeper on waters that are preserved for fishing, who has always his traps set for them. This is somewhat strange when it is remembered that the Otter is also an animal of the chase, packs of Otter-hounds still being kept like fox-hounds in certain districts, though the packs are by no means so numerous as in former times. The flesh of the Otter is rank and fishy-flavoured, and therefore not in demand for human food ; but there are many records showing that it has been esteemed for use on days when the rules of the Church permitted fish only to be eaten, the clerical casuists easily finding that as it spends most of its active life in the water and has a fishy taste, it must be a kind of a fish ! Readers of dear old Izaak Walton will remember the Otter-hunter's reply when Piscator asks him whether he hunts a beast or a fish. The Huntsman says—

"Sir, it is not in my power to resolve you ; yet I leave it to be resolved by the College of Carthusians, who have made vows never to eat flesh. But I have heard the question hath been debated among many great clerks, and they seem to differ about it ; yet most agree that *her tail is fish* ; and if her body be fish too, then I may say that a fish will walk upon land (for

an Otter does so), sometimes five or six or ten miles in a night."

More recently Pennant says he saw an Otter in the kitchen of the Carthusian monastery near Dijon, being prepared for dinner.

There have been many cases of tame Otters who hunted streams for fish for the benefit of their owner, to whom they return on hearing a whistle or other signal. Some years ago an interesting account appeared in *The Field* of an Otter whelp that had been mothered by an Otter-hound, afterwards hunting its own kind with the pack.

Pine Marten (*Mustela martes*, Linn.).

The Pine Marten or Marten Cat was formerly quite a common woodland beast, but owing to the onslaughts of the gamekeeper and the high prices paid for a skin, it is now, so far as southern and midland England is concerned, extinct. In the wilder parts of the Peak district, the North of England, Wales, Scotland, and Ireland, however, it still exists, though in small and ever decreasing numbers in most places. In the Lake District it was quite recently reported to be fairly common even. The name *Pine-Marten* is a misnomer in so far as it indicates that the animal is at all restricted to pine-woods; and it is probable that in the past it led to confusion, for in all the natural histories published up to a late date in the nineteenth century, Britain was credited with an additional species, the Beech Marten (*Mustela foina*). The two species are much alike, and the practice appears to have been to record those found in pine-woods as *M. martes* and those in other woods as *M. foina*! Bell, indeed, though he expressly states his disbelief in our possession of two species of Marten, refers to the white-throated form as the Beech Marten or Common Marten and says it is more frequently met with than the yellow-throated form or Pine Marten. The

truth is that there is a white-throated *Mustela foina* in Europe and Asia, but it does not reach northward so far as Sweden, Norway, or the British Isles. The white examples found in this country are old animals from which the yellow tint has faded.

The Pine Marten may be described as resembling roughly the better-known Polecat, but with longer legs, a broader, more triangular head with sharp-pointed muzzle, and a longer, more bushy tail. Its entire length is between twenty-five and thirty inches, of which from nine to twelve inches are contributed by the tail. Its colour is a rich dark brown, except on the throat and breast which vary from orange through yellow to creamy-white. The middle of the back and the exposed sides of the legs and feet are darker than the rest, whilst beneath the tint approaches grey. The superficial colour is provided by the long upper, glossy fur, but beneath this is a finer, softer fur of shorter reddish-grey hairs tipped with yellow. The eyes are large, black, and prominent, the ears broad, open, and rounded at the tips. Like all the other members of the family Mustelidæ, the Marten is provided with glands near the base of the tail. It is these which enable the Skunk and the Polecat to disgust their enemies; but in the case of the Marten the secretion is merely of a musky odour and not objectionable; in consequence one of its old English names was Sweet Marten to distinguish it from the Foulmart or Polecat.

The habits of the Pine Marten are mainly arboreal, for which the long slender body and sharp long claws specially fit it, whilst the long bushy tail is useful as a balancer in negotiating slender branches in the pursuit of birds, or in reaching their nests for eggs. All the same, the Marten is at times very active on the ground where he destroys rats, mice, voles, rabbits, hares, game-birds, and domestic poultry large and small. He is even accused of attacking lambs and stealing trout from the fishing boats. He has also a taste for bilberries, strawberries, cherries, and raspberries; and C. St. John tells



Pl. 42.

E 64.

Stoat.

Characteristic hunting attitude.



Pl. 43.

Weasel.
Killing a rabbit it has outrun.

F 65.

an interesting story in this connection which illustrates the Marten's cleverness in hiding. He says: "I saw in my garden in Inverness-shire that some animal came nightly to the raspberry bushes; the track appeared like that of a rabbit or hare, but as I also saw that the animal climbed the bushes, I knew it could be neither of these. Out of curiosity, I set a trap for the marauder; the next morning, on going to look at it very early, I could see nothing on the spot where I had put my trap but a heap of leaves, some dry and some green; I was just going to move them with my hand, when I luckily discovered a pair of bright eyes peering sharply out of the leaves, and discovered that I had caught a large Marten, who, finding that he could not escape, had collected all the leaves within his reach, and had quite concealed himself under them. The moment he found that he was discovered, he attacked me most courageously, as the Marten always does, fighting to the last. I had other opportunities of satisfying myself that this animal is a great fruit-eater, feeding much on the wild raspberries, and even blackberries, that grow in the woods." It also robs beehives of their honey.

The female Marten forms a nest of grass among the rocks, in a hollow tree, or utilises an old crow's nest by relining it, and produces a litter of four or five—sometimes varied in number from two to seven—and there are at least two litters each year. The young are exceedingly pretty and are easily tamed; though a captured adult is savage and untameable.

The dentition of the Marten is: $i \frac{3}{3}$, $c \frac{1}{1}$, $p \frac{4}{4}$, $m \frac{1}{2} = 38$.

Cuvier divided the Linnean genus into two subgenera, *Mustela* and *Putorius*, the first, Martens and Sables, possessing an additional small premolar on each side of the jaw; the second including the Polecats, Stoats, and Weasels. At a later date Nilsson called these subgenera genera, substituting the name *Martes* for the Martens and giving that of *Mustela* to the Weasels. This has the effect of making the

name of the Pine Marten, *Martes martes*, which is rather ridiculous ; and we have preferred to retain the Linnean name *Mustela martes*. The old spelling of the popular name was *Martin*, but in recent works, to avoid any possible confusion with the birds of that name, zoologists have agreed to use *e* as the second vowel when writing of the mammals.

The Pine Marten is found in all the wooded regions of Europe and into Asia ; northwards from the Mediterranean to the limits of tree-growth.

Stoat or Ermine (*Mustela erminea*, Linn.).

Though the gun and the snare of the gamekeeper and the poultry-farmer levy their toll upon the Stoat equally with the Polecat, and the keeper's gibbet always shows a goodly row of Stoats, the species manages to keep itself well represented, even in the strictly preserved woods of Southern England. There must, therefore, be some additional reason for the scarcity of the Polecat (see p. 74).

The Stoat is much smaller than the Polecat, its total length being only a little more than fourteen inches, of which about four and a half inches are the long-haired but not very bushy tail. In colour, too, it is very distinct, the upper parts being red-brown and the under surface white tinged with yellow. The tail takes the colour of the upper surface, except its tip which is invariably a tuft of long black hairs. In the Alpine districts of Scotland as in other northern countries, the fur in winter becomes pure white all over, with the exception of the tip of the tail which always remains black. This change takes place also in the North of England, but not so generally, and in the South it is only of rare occurrence, and often only partially, some parts remaining brown, as a ring around the eyes producing a spectacled appearance. The summer coloration is "protective" inasmuch that it harmonises generally with the

colour of the ground littered with the remains of dead leaves, bark, etc. ; but in a landscape under snow for months, as the Alpine districts are, the brown fur would render the animal so conspicuous that it would be heavily handicapped in the hunt for food ; but the winter change to white fur enables the Stoat to steal upon its prey unseen from a short distance. The change is quite sudden, given the requisite fall in the temperature, the pigment being withdrawn. (See Introductory chapter.)

Like the Polecat, the Stoat can secrete a most objectionable odour from its scent-glands, but in this case it is not nearly so insupportable. St. John says that if the Stoat is suddenly shot before he has had time to see his aggressor the dead body has not this offensive odour ; the same result follows upon his sudden death in a spring trap, but if he is trapped alive or hunted before being shot the vile smell is imparted to the fur and is irremovable.

The Stoat hunts along hedgerows, rivers and brooks, in the latter places for fish, of which all the members of the Weasel tribe are exceedingly fond. An eel or other fish placed in a trap is a deadly bait for these animals. The Stoat also frequents sand dunes, where it lives sumptuously upon Rabbits. It is very destructive to game and poultry, which it will attack right in the open field, and if pursued by a dog, immediately takes shelter in a mole's or rat's run, where pursuit is impossible. It will destroy the Mole and take possession of its chamber, though it appears to be fonder of "field mice" (Voles) than of Moles. Although largely nocturnal in its habits, it is by no means exclusively so, and there is more chance of observing the Stoat hunting in broad daylight than in the case of any other of our native carnivora. Sometimes it hunts in small packs—family parties ; and it is said that when through increase of its own numbers it has largely reduced the food supply of a district, it will migrate in large numbers, when their associated courage is so great that they will attack a man. A single

female who has young will, indeed, exhibit the greatest courage and ferocity in their defence. The Stoat hunts by scent, and its movements consist largely of a succession of low bounds which give its progress a snake-like appearance—and like the other members of the family it makes sidelong leaps. Many years ago, whilst walking along a woodland road in Surrey, we paused to listen to cries of terror in the cover far ahead. A panic-stricken young Rabbit came into the open in our direction swiftly pursued by a Stoat which rapidly gained upon it. As it came near the Rabbit became aware of our presence and appeared deliberately to change its course, and fell on its side exhausted against our feet. The Stoat, by this time only a few yards away, stopped, and looked up at us with a snarling expression, but kept out of reach of our uplifted stick. Realising that the hunt had failed and the Rabbit had found a spoilsport protector, the Stoat then made off into the bracken; whilst the panting Rabbit allowed us to carry it on our arm for half a mile until it had recovered. Its natural fear of man was not nearly so great as its terror inspired by the bloodthirsty Stoat; and when at length it was set down in what was judged to be a safe place, it hopped off without any frightened haste.

It appears that the Hare under similar conditions does not exert itself greatly to escape from the Stoat, but becomes so terrorised as to be unable to adopt methods which so frequently outwit the Fox or the fleetness of trained hounds.

The nursery is made in a hole in the bank, the hollow of a decayed tree, or in the retreat of a female Mole who has been killed or evicted. Here about April or May the female Stoat gives birth to four or five young, which she will defend with great fierceness against all dangers.

The distribution of the Stoat extends eastward from Great Britain into Asia, and from the Alps and Pyrenees across Europe to its arctic shores.



Pl. 44.

Weasel's Hole.

F 68.

in woodland bank, containing nest and young.



Pl. 45.

Polecat at Bay.
Defying a human intruder.

F 69.

A local race of smaller size, with some variation in the colouring, is found in Ireland, and some systematic naturalists, eager to swell our short list of native mammals, have dignified it with a separate species name—*Mustela hibernicus*. In Ireland it is known as the Weasel, but no specimens or skins of the true Weasel (*Mustela nivalis*) have ever been received from that country. Another local race in the Isle of Jura on the west coast of Scotland is similarly given species rank.

Weasel (*Mustela nivalis*, Linn.).

Although of very similar form to the Stoat, the Weasel may be known by its smaller size and by the absence of the black tip which marks the tail of the Stoat. In colour there is little difference in the two species, except that in the Weasel the upper parts are of a redder brown and the under parts a purer white than in the Stoat. The head is narrower and the legs are shorter, whilst the tail, which is a conspicuous feature of the Stoat, is here less bushy and little more than half the length of the Stoat's appendage. The average length of a mature male is nine or ten inches, to which the tail contributes only two inches; the total length of the female is an inch and a half less than that of the male.

The long, slender body, short limbs, long neck and small head give it a snake-like appearance which is helped by its active, gliding movements. The snake-likeness is accentuated when only the foreparts are seen protruding from a hole. On one occasion as we passed a stack of cord-wood on the edge of a wood, our attention was attracted by a hissing noise. On the level of our face a snake-like head peered out from between the cord-wood; and many persons would, no doubt, assume that a snake had threatened them. But the snarling expression exposed the canine teeth. The cause of the demonstration was not obvious, but we presumed that there were young Weasels in

the stack, and that some other predatory animal had threatened danger to them just before we passed, and had aroused the maternal rage. In spite of its small size the bloodthirsty Weasel is full of courage, and will attack creatures larger than itself. We have seen it, in the neighbourhood of a barn, struggling to haul along a nearly full-grown Rat, two or three times its own weight, after it had paralysed its victim by biting through the base of the skull. Sometimes it hunts in couples, or family packs.

Although, like the other members of its family, the Weasel is chiefly nocturnal in habit, it is also active by day, and may be encountered frequently in our rambles. His diet is varied, and includes rats, mice, voles, moles, frogs, small birds, and chickens. He will swim in pursuit of the Water Vole, and will climb trees and bushes in order to rob a bird's nest of eggs or young. Voles and mice are probably his principal victims, his small size enabling him to pursue them in their underground runs. But though the farmer may lose some of his chickens through want of care in protecting fowl-houses and runs, he has in the Weasel a most efficient guardian of his mangold-caves and other consumable stores. Many farmers have testified that their poultry is untouched by the Weasel, but destroyed by the Stoat.

One winter's day in Cornwall we were strolling up a road from the sea that ran between farm buildings, when our attention was attracted to the peculiar movements of some object on the road about a quarter of a mile ahead. Screaming cries came from the rolling mass, and soon we got near enough to see that a struggle was going on between two creatures who were mixed intimately; and finally saw that a large, well-fed Rat had been taken in charge by a lithe little Weasel. Spots of blood on the road and the redness of the rodent's neck-fur showed that the bite that rendered the Rat powerless had been given already. So intent was the Weasel upon the work in

L. 40.

Wild Cat.

F. 70.





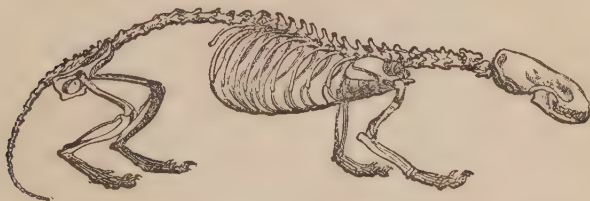
Pl. 47.

Weasel.
Mustela nivalis

F 71.

hand that for a moment he appeared ignorant of our presence within a few feet. Then he paused, stood upright on his haunches, and looked up with a fierce gleam in his bright black eyes that seemed to say, "Don't interfere, there's a good fellow. I've tackled him fairly—let me finish the job." That slight pause gave the Rat a chance—a very poor one, but he tumbled in a stupid, drunken kind of way towards the hedge, to which the Weasel had been trying to drag him.

On the other side of the hedge was a "cave" of mangolds upon which the Rats had been committing fearful ravages, as is their wont, and this particular thief had waxed fat upon such



Skeleton of Weasel.

fare. The Weasel had evidently caught him in the act of committing larceny, but the Rat had given the little policeman a run through the hedge and across the road before the Weasel had leaped upon the culprit's back and inflicted the deadly bite. So much was told with tolerable certainty by the drops of blood and the footprints on the soft road. Now, getting somewhat alarmed at our presence, the Weasel ran into the hedge; but immediately rallying his pluck came out of his corner again, seeking his quarry who was at the hedge-foot, dreamily looking for the hole that in ordinary health he would have darted to straight. He floundered hopelessly under the herbage; but in a second or two the Weasel had him again by the skin of the back, and was trying to haul him up the bank to get him

through the hedge. Then, realising the impossibility of his task—for the Rat was probably six times the Weasel's weight—and finding we had taken up an attitude of benevolent neutrality, not loving Rats, he got on the Rat and finished the business. A few spasmodic movements of the extended limbs showed that the Rat was dead, so we left the Weasel to enjoy his feast of brains in the solitude he desired.

When the Weasel has failed by stalking or hunting such prey to secure a meal, he is known to resort to "charming" tactics. In full view of a hedgerow where small birds are numerous, he will throw his body into snake-like contortions to attract their attention. They become fascinated and curious, and though apparently filled with fear, they approach nearer and nearer until one is close enough to be grabbed by the charmer. Then the others recover their senses, and in numbers fly at the Weasel, mobbing and pecking him in a fearless manner, so that he is coerced by the defenceless creatures he intended to kill, and is glad to slink into cover. If there is a scarcity of live food, the Weasel will content himself with carrion. Its chief enemies are hawks.

There is, as a rule, no seasonal change of colour in the Weasel's fur in this country; but occasionally it has been found white in winter. In colder climates this change is quite normal.

The Weasel's nest is placed in a hole in the bank or in some hollow tree, and consists of dry leaves, grass, etc. In it the female brings forth from four to six—usually five—young, in spring or early summer; and the mother will sacrifice her own life in the defence of her helpless progeny. If necessary to remove them, she does it as a cat removes her kittens.

In the north it is known as the Whittret = Whitethroat of Suffolk; in Yorkshire, the Kessel; in Cheshire, the Mouse-killer; in Sussex, the Beale; and in some parts of Surrey as Kine, which suggests Gilbert White's Cane, the local name in

Hampshire for "a little reddish beast not much bigger than a field-mouse, but much longer," of his fifteenth letter to Pennant. The more general name Weasel is the Anglo-Saxon *Wesle*.

When Scotland suffered severely from a "plague" of Field Voles in 1892, the Board of Agriculture appointed a Committee of Enquiry, and the examination of witnesses—farmers, keepers, shepherds—clearly established the fact that the chief natural enemy of the Field Vole is the Weasel, and that the gravest mistake had been made in destroying and in exporting large numbers to our Dominions in order that they might there reduce the "plague" of Rabbits. It was even suggested that we should make good this error by importing Weasels from the Continent and turning them loose. Other evidence showed that the Weasel is frequently blamed by game-preservers for what is undoubtedly the work of the Stoat, the Weasel preferring the lower-lying farmsteads, where Mice and Voles are abundant, to the elevated ranges frequented by Grouse and Rabbits. Apart from its preference for the smaller Rodents, the Weasel appears to differ from the Stoat in being of a less hardy constitution, and in winter at least requires the shelter afforded by granaries and rickyards, where it co-operates with the Owls in an unceasing warfare on the Rats and Mice. Its extra-British distribution agrees with that of the Stoat.

Albino-Weasels, with pure white fur and pink eyes, have been recorded several times, but they appear to be very rare.

Polecat (*Mustela putorius*, Linn.).

In contradistinction to the Sweet-mart already described, our forefathers called the Polecat or Fitchew the Foumart or Foul Marten, because the secretion from the glands under the tail is intolerably acrid and mephitic; on this account the fur is considered useless, the odour attaching to it permanently. Like the Marten, the Polecat, thanks mainly to the unremitting

vigilance of the gamekeeper, has become very rare in this country. In this case there can be no doubt that the keeper is fully justified, for there is no more destructive beast among our native carnivora. It is still common throughout Europe, as far north as central Scandinavia.

Though in general appearance similar to the Marten, the Polecat is smaller, has shorter legs and a shorter tail, and differs in colour. The entire length is about two feet, but of this the bushy tail accounts for about seven inches. Its long coarse fur is dark brown on the upper parts of the body, and black on the undersurface. The head, also, is blackish, relieved with white marks about the muzzle and between the ears and eyes. The weight of a full-grown Polecat is about six pounds.

Its usual habitat is a wood or copse, not too far from a plunderable farm ; but it has no fixed type of dwelling, taking advantage of any hole, be it a fox-earth, a rabbit burrow, or a natural rock crevice ; often indeed a woodstack in the farmyard may be utilised. On the approach of winter it looks out for some deserted building where it can find shelter. Unlike the Marten, it is not much of a climber, and does not exhibit the sprightly agility of that species. It is a nocturnal hunter, and is an adept at finding entrance to a hen-house, where it has been known to kill off every one of the inmates in a night, though it could only make off with a solitary hen. Although it may consume the brains of its victims on the spot, the bodies are always carried to its lair for more leisured consumption. Its food includes eggs of all kinds, rabbits, rats, mice, birds, fish, frogs, lizards, and snakes, including the viper, whose poison is considered to be innocuous in the blood of the Polecat. When it gets into the poultry yard, the superior size of some of its victims does not alarm it ; a goose will serve its turn as well as a chicken. Bell tells of sixteen turkeys that were killed in one night by a single Fomart ; though, of course, it could not drag away one of the carcasses. Its usual method of carrying smaller

L¹, 48.

Polecat.
Mustela putorius.

F 74.





Pl. 49.

Young Squirrels.

The side of the "drey" has been removed.

F 75.

prey is to grip them by the middle of the back, much as a retriever carries game. In addition to the remains of hares, rabbits, numerous birds, and several eels, C. St. John found in the larder of a she-polecat the bodies of three kittens which he knew to have been drowned at least a quarter of a mile away.

The Polecat pairs about February, and from three to eight (mostly five or six) young to a litter are born in April or May. The nest is made of dry grass. There is probably a second litter a few months later.

The dentition of the Polecat, the Weasel, and the Stoat, is the same as that of the Marten, except that there are only three premolar teeth on each side of the jaws. In setting traps for Polecats the bait is found to be rendered far more seductive by scenting it with musk.

The tame Ferret, so largely bred for use in catching Rabbits and destroying Rats, is an albino, probably of the Asiatic Polecat (*M. evermanni*), with yellowish-white fur and red eyes. Its employment in hunting ground-game dates back certainly as far as to the Romans, as evidenced by references in Pliny's Natural History. When all the exits but one from a Rabbit "bury" have been netted, the Ferret, properly muzzled, is turned into the one left open, and quickly drives out all the occupants into the nets. In similar fashion Rats are driven out of their holes to have their backs promptly broken by terriers in waiting. Dark-coloured Ferrets are known as Polecat Ferrets, and appear to be hybrids between the Ferret and the ordinary Polecat.

Wild Cat (*Felis silvestris*, Schreber).

When in England or Ireland we talk with keepers or other woodland folk, and they happen to mention Wild Cats, let it be understood always that *their* wild cat is a domestic pussy that

has tired of the soft indoor life and become feral. Such cats are a terror to the gamekeeper on account of their destruction of young pheasants, hares and rabbits, and the tails of many of them ornament his gibbets.

To have even a slight chance of seeing the real British Wild Cat to-day, we must seek it in North Wales, or preferably the north or north-west of Scotland, its present restricted area in that country having as its eastern boundary the Caledonian Canal. It inhabits the most lonely and inaccessible mountain sides, hiding during the day in some rocky fastness, prowling far and wide at night in search of prey. It is of a general yellowish grey colour, but individuals differ in their dark brown markings, some having vertical stripes running down the sides from a black longitudinal line down the middle of the back ; in others these are broken up to form spots. It has a squarish thick head and body, the latter longer than in the Domestic Cat ; but the thick bushy tail is relatively shorter, ringed and ending in a long black brush. The limbs, too, are longer than those of the tame cat, so that it stands higher. A pair of dark stripes extend from the eyes and over the head to behind the ears. The fur is long, soft and thick. The pads of the toes are not quite black. The average length is about two feet nine inches, of which the tail accounts for eleven inches ; but there is a record of a Scottish example measuring three feet nine inches in all.

Pennant (1776) says : "This animal may be called the British tiger ; it is the fiercest, and most destructive beast we have ; making dreadful havoke among our poultry, lambs and kids." C. St. John, nearer to our own time (1845), says its strength and ferocity when hard pressed are perfectly astonishing. Fully acquainted as he was with the wild life of the more remote parts of Scotland, he adds : "I have heard their wild and unearthly cry echo far in the quiet night as they answer and call to each other. I do not know a more harsh and unpleasant



Pl. 50.

Squirrel's way with nuts.

F 76.

Empty shells showing the neat work of the incisor teeth.



Pl. 51.

Grey Squirrel.
Sciurus cinereus.

F 77.

cry than that of the Wild Cat, or one more likely to be the origin of superstitious fears in the mind of an ignorant Highlander." He describes how one day whilst fishing in Sutherland, and having to climb over rocks to get from one pool to another, he had a close personal encounter with one.

"In doing so, I sank through some rotten heather and moss up to my knees, almost upon a Wild Cat, who was concealed under it. I was quite as much startled as the animal herself could be, when I saw the wild-looking beast so unexpectedly rush out from between my feet, with every hair of her body standing on end, making her look twice as large as she really was." Pursued by his three Skye terriers "she took refuge in a corner of the rocks, where, perched in a kind of recess out of reach of her enemies, she stood with her hair bristled out, and spitting and growling like a common cat. Having no weapon with me, I laid down my rod, cut a good-sized stick, and proceeded to dislodge her. As soon as I was within six or seven feet of the place, she sprang straight at my face over the dogs' heads. Had I not struck her in mid-air as she leaped at me, I should probably have got some severe wound. As it was she fell with her back half broken amongst the dogs, who, with my assistance, despatched her. I never saw an animal fight so desperately, or one which was so difficult to kill. If a tame cat has nine lives, a Wild Cat must have a dozen."

The female makes a nest in some remote rock-cleft or hollow tree, where in early summer she usually brings forth four or five kittens, which at an early age spit angrily at any intruder.

The distribution of the Wild Cat includes Europe and Northern Asia to the North Himalaya. Though formerly a beast of chase in England, it appears never to have been a native of Ireland. Old English names for it were Catamount and Cat-a-mountain.

Dental formula: $i \frac{3}{3}, c \frac{1}{1}, p \frac{3}{2}, m \frac{1}{1} = 30$.

Squirrel (*Sciurus vulgaris*, Linn.).

With the beautiful Squirrel, the most popular of all our native fauna, we make the acquaintance of another order of animals, the Rodentia or gnawing mammals, which is the most numerously represented of the orders in our meagre list, Britain still possessing fifteen species of rodents. Besides the Squirrel, the order Rodentia includes the Dormouse, the Rats, Mice, and Voles, the Hares and Rabbit; and the characteristic feature that brings them together is the chisel-like pattern of their incisor teeth. (See Introduction.) They may be said to be the dominant race of mammals in the present day, for whilst over a thousand species are known to science, and these mostly of very wide geographical range, there are vast and increasing numbers of individuals representing many of the species. Whilst man is busy killing off the carnivora and the birds of prey, these natural checks to the multiplication of the Rodents are being missed seriously, and Rats, Hamsters, and Voles prove a serious menace to man's agricultural produce, and the Rat to his health owing to its instrumentality as a carrier of disease.

A distinctive character of the Rodents, additional to the chisel-teeth and the absence of canines, is the possession of hairy linings to the mouth, the external skin being continued into the sides of the mouth behind the upper front teeth. In the Hares and Rabbits the whole of the inside of the cheeks is covered with hair.

Very few of the Rodents are aquatic in their habits, and of these few the Water Vole is the only British representative. Most of them are burrowing animals, and excavate long runs and nesting places in the earth; a few, like the Squirrels and Dormice, are arboreal. As a whole the Rodents may be said to be vegetarians; but the Rats are omnivorous, and the Water Vole though mainly herbivorous takes a little animal food.

The Squirrel is one of the most picturesque of our small mammals, especially when seen sitting on his haunches on a tree branch, his plummy tail curled up his back, his tufted ears erect, and his forepaws holding a nut ; or when making his prodigious leap from bough to bough. He is not nearly so big a creature as he looks under these conditions, for if we could pass the tape over him from the end of his snout to the tip of his tail proper (that is, not including the hairs that extend beyond the tip), we should find he only measures about fifteen and a half inches, and of this length seven inches, or nearly half, is provided by the tail. Examine his feet, and you will see that they are adapted eminently for climbing. The fore-feet have four fingers and a rudimentary thumb, and the hind feet have five toes ; the claws long, curved and sharp-pointed, and the soles hairy. The muzzle is well furnished with "whiskers," the prominent eyes are black and bright, and the large, pointed ears bear tufts of long hairs in winter. The hind limbs are much longer than the fore limbs, and the heel of the long foot touches the surface upon which it rests. The upper parts and tail are brownish red and the under parts white. Before winter, when the fur becomes softer and thicker, a grey tinge is developed on the sides, and the ear-tufts become longer and bushy ; these are shed in the breeding season (early summer). At times it may be found with the tail of a creamy tint.

One of the Squirrel's strong claims to popular favour is his diurnal habits, which makes him better known by all who wander in the woods ; in one sense it is a pity it is so, for in the neighbourhood of large towns the "sporting instinct" of 'Arry has led him to kill or mutilate the Squirrel with sticks and stones. Not many years ago the numerous Squirrels that added to the attractions of Richmond Park were shot by the keepers to prevent 'Arry killing them ! Ordinary intelligences thought it would have been better to have disciplined 'Arry.

The Squirrel builds nests in the branches of the trees it affects,

not merely as nurseries, but for resting places. There may be several of these in adjacent trees or in the one to which the builder is specially attached. Some of these may be crows' or magpies' nests adapted for the new tenants, or may be wholly the Squirrel's work. They are bulky structures composed of twigs, strips of thin bark, moss, and leaves; sometimes cup-shaped, others domed. These are usually known as "dreys";



Skeleton of Squirrel.

but in parts of Surrey they are "jugs," squaggy-jugs to give them their full name. The breeding nest is a huge ball (unless there is a roomy hollow in the trunk that can be upholstered) with a side entrance. Here in summer the three or four blind and naked young are born, and they remain with their parents until themselves adult.

The food of the Squirrel is fairly varied. In pine woods the cones provide the staple dish, and the ground beneath a

Nest of Dermouse.

Mother removing her young





Pl. 53.

Squirrel.
Sciurus vulgaris.

G 81.

Squirrel's tree will be found littered with chips and cores of the cone from which the seeds have been extracted. This *débris* should be looked for as an unfailing sign that there are Squirrels in the wood. In beech woods they rely largely on beech-mast, the sharp-edged triangular seeds contained in the prickly nuts. They usually have a hazel-copse not far distant whence they derive their favourite food in the autumn, storing up considerable quantities in holes for use during the winter. Several times when filling our own pockets with hazel-nuts we have met with angry protests from a Squirrel who considered the place his own preserve. Standing on a stout limb just overhead he would stamp his forefeet and utter a little bark. Similar objection has been made at times when we were filling our basket with the nutty Blusher Toadstool (*Amanita rubescens*), of which some of the caps in a clump showed the marks of the Squirrel's incisors. He is also fond of cherries, wild or cultivated, and the shoots of Pines which contain the burrowing larvæ of the Pine Tortrix moth. It is also accused of being so far carnivorous as to consume bird's eggs and nestlings.

The Squirrel does not hibernate, as it is said by the older writers to do. In the winter it certainly indulges in long naps; but on a fine day it wakes up and visits its stores of food. It rarely descends to the ground, except for the purpose of crossing a wide woodland road, or to seek water at a stream. In connection with water, it may be said that the Squirrel is an expert swimmer. Dental formula: $i \frac{1}{1}, c \frac{0}{0}, p \frac{0}{0}, m \frac{5}{4} = 22$.

The Squirrel is generally distributed in Great Britain and Ireland, where there is sufficient woodland, and in similar situations in Europe and Asia.

Grey Squirrel (*Sciurus cinereus*, Linn.).

In some places in the London district a light grey Squirrel may be seen, and thought to be a colour variation of our native

species. It is really an American visitor, distinct in colour and without tufts to the ears. Some years ago the caged specimens in the Zoological Gardens, Regent's Park, had become so numerous that some of them were given their liberty. Their numbers increased among the trees of the Gardens, and they overflowed into the Park, where they became so familiar as to accept food from the hands of the delighted children. Gradually, some of them developed exploring tendencies and made their way to the wooded grounds of suburban residences. British naturalists of a not-distant future will probably have to include two species of Squirrels in their lists.

The pretty Chipmunk (*Tamias striatus*, Linn.), or Chipping Squirrel, one of the Ground Squirrels, is another American species that has become acclimatised in the London area. It lacks the long tufted ears of our Squirrel, the tail is shorter, and there are pouches inside the cheeks. Its general appearance is strikingly different from the Squirrel, for though its ground colour is red-brown, the eye is set in a white band divided into two stripes by a black line. A black stripe runs down the middle of the back, and in addition there is a white stripe bordered by black above and below along each side.

It feeds on nuts, beech-mast, grain, roots, and insects ; migrating from place to place as local food-supplies become scanty. It stores up food for the winter like the Squirrel, carrying it to its caches by means of the cheek-pouches. Though capable of climbing, and occasionally seen ascending lofty trees, it is much more at home on the ground. It burrows a retreat in the ground, if no suitable stump is available for excavation. When startled it utters a cry of "chip-per-r-r."

Dormouse (*Muscardinus avellanarius*, Linn.).

The non-scientific observer of our native mammals satisfied himself long ago that the pretty Dormouse was a miniature kind



Seeking for thistle-seeds.



Pl. 54.

Fighting for a wheat-ear.

Harvest Mice.

G 82.



Pl. 55.

Dormouse.

Muscardinus avellanarius.

G 83.

of Squirrel, and he was helped to this conclusion by the general resemblance in colouring, the form of the head, the prominent black eyes, large ears, and thickly furred long tail ; as well as by its arboreal habitat and its habit of sitting up on its haunches and holding a nut or other food in its fore paws. But the classifying naturalist has to look below the surface to discover a sound basis for his work. Superficial resemblances are often due to similarity of habit and habitat ; and in this case the internal structure of the Dormouse shows that it has closer



Skeleton and Molars of Dormouse.

affinity with the Mice than with the Squirrels, though really distinct from both.

The total length of the Dormouse is about five and a half inches, but nearly half of this is contributed by the tail. The fore limbs, which are much shorter than the hind limbs, are furnished with four separate fingers and a rudimentary thumb ; whilst the hind feet have five toes, though the first of these is short and clawless. All the claws are short ; and on each foot there are six large pads. The fur of the upper parts is light tawny coloured, and of the underside yellowish white, but the throat and adjoining part of the chest is a purer white.

In the copse and thick hedgerow where the Dormouse is mostly to be found, he must be sought after the brightness of

day has departed ; for he is a nocturnal beast and spends the hours of sunshine in heavy slumber. So deep is his somnolence, and so low his temperature, that one not accustomed to his ways might easily imagine him to be actually dead. It is not a case of "sleeping with one eye open" with the Dormouse ; he needs, as it were, to be shaken to arouse him. One autumn many years ago we frequently found the empty shells of cob-nuts in our greenhouse, and were somewhat puzzled to account for their presence. A thick row of cob-bushes in our neighbour's garden ran along the back of the greenhouse, but we never suspected that they were haunted by Dormice. One day in selecting a flower-pot from a number of empty ones that lay "nested" one within another a hoard of splendid nuts was found occupying the available space in several of them. Then a common box mouse-trap was set, and next morning it contained a plump Dormouse, curled up on its back with all the appearance of death, and it was lifted out by the tail without immediately awaking. Four or five were caught in this manner on successive nights.

For diurnal privacy and comfort the Dormouse constructs a globular nest of twigs, moss and grass, about three inches in diameter (sometimes with a circular opening), which may be among the stubs in the coppice, beneath a tussock of grass, or even suspended high up in the bushes. The nursery nest is twice this size. In some districts the nest will be constructed of the bark of old honeysuckle stems, which shreds off in ribbons. The inner lining is of the same material more finely divided, with a bed of leaves. Several litters of three or four, or even six or seven, blind and naked young are born in spring or summer ; but there are also records of young being found in September or October. Having regard, however, to the hibernating habit of the species it is probable that these perish, for autumn-born young would scarcely be in fit condition to go without food for a long period. In their first coat the young

are more grey than red, but gradually assume the adult tint. There are no scent glands.

The adults have usually retired by the middle of October, by which date they have prepared for a long sleep by accumulating much fat beneath their coats, and make further provision by laying up a store of nuts. The reason for the latter is that the Dormouse's sleep is not continuous. It wakes up at intervals, has a good meal, and resumes its sleep. Its activities are not resumed until the spring, so that its retirement lasts nearly for half the year. Its winter nest is usually under moss among roots, or far underground. Its sleep is profound, without breathing, and it becomes absolutely cold.

The food of the Dormouse is much the same as the Squirrel's, but it is particularly fond of the hazel-nut, a good fat producer, and the "haws" of the whitethorn. It does not crack the shell of the nut, but gnaws quite a small hole, extracting the kernel piecemeal. In addition it eats many insects, and sometimes indulges in birds' eggs or even the birds themselves, if they can be captured.

The Dormouse is frequently kept as a pet for children, for which its gentle, fearless manner and non-disposition to bite seem to make it specially suitable; but we have found it regarded by youngsters as "a bit of a fraud" in this character, for as they have said, "It doesn't wake up until we are asleep." We have found that in semi-captivity it woke on most evenings throughout the winter to enjoy a supper of apples and nuts. Freshly captured specimens become tame at once. Ours were fond of climbing the long window curtains and hunting for flies—for the Dormouse is insectivorous as well as frugivorous. It is not given to the gnawing of wood, like the true Mice; and it is said to be one of the creatures that are immune to Viper poison.

The Dormouse is a European animal, but it does not extend northwards of Sweden. In agreement with this distribution,

it does not occur in Scotland. From Ireland it is entirely absent. Eastward it extends only to Asia Minor.

The head is comparatively large, with blunt muzzle, prominent eyes, broadly rounded short ears, and long whiskers. The dentition is much the same as that of the Squirrel: there is a single large incisor on each side of the upper and lower jaws, and one premolar and three molars after a considerable blank: $i \frac{1}{1}$, $c \frac{0}{0}$, $pm \frac{1}{1}$, $m \frac{3}{3} = 20$. The enamel ridges of these cheek-teeth constitute a rasping surface such as no other mammal possesses.

The soft, dense fur of the Dormouse was of repute anciently as a remedy for ear diseases and paralysis. The English name can be traced back certainly to the fifteenth century, and is considered to embody the verb *dorm* = to doze, still used in the North of England, which brings it very close to the Sleepmouse of Southern England and Sleeper of other parts. Derrymouse, Dorymouse, and Dozing-mouse are other local variants.

Albino varieties are very rare; but individuals with white-tipped tails are reported not infrequently.

Harvest Mouse (*Micromys minutus*, Pallas).

With the exception of the Lesser Shrew the pretty little Harvest Mouse is the smallest of British mammals. It long held that distinction, until the Lesser Shrew was shown to be a distinct species and not the young of the Common Shrew. The Harvest Mouse will always be associated with the name of Gilbert White, for it was in his letters to Pennant that it was first made known as a British mouse, and its appearance and habits were published by Pennant in his "British Zoology."

The head and body combined measure less than two and a half inches, and the nearly naked, scaly tail is almost as long. The thick, soft fur of the upper side is yellowish-red in colour,



Pl. 56.

Harvest Mouse (enlarged).
Micromys minutus.

G 86.



Pl. 57.

Nest of Harvest Mouse.

G 87.

The wonderfully woven ball which serves as nursery.

and of the under parts white; the two colours being rather sharply separated. The tail is exceedingly pliant and prehensile, and serves as an additional foot, being at once coiled around any suitable object within reach. It has bright black eyes, short blunt nose, and short rounded ears, the latter about one-third the length of the head.

It is found chiefly in the South of England, becoming less abundant as we go north. In Scotland it is very scarce, and it does not occur in Ireland. It is more generally distributed on the Continent, where it ranges from Northern Italy to Russia and Siberia. The usual habitats of the Harvest Mouse are pastures and cornfields, where it climbs the stems of the tall grasses and corn plants, cutting off the ripe ears and carrying them to the ground where it picks out the grain. During the summer it feeds largely upon insects, caught in the same situations. At the same season it stores up much grain in burrows for use in the winter between its periods of sleep. Sometimes, however, instead of wintering in burrows in the earth, it tunnels into hayricks, and if undisturbed may even bring up a litter or two in the rick; as a rule it constructs the wonderful nursery which has won human admiration ever since White made the species known.

This is a ball-shaped nest about three inches in diameter formed of neatly plaited and woven blades of wheat or grass, with no definite opening, the grass-blades being merely pushed aside to make entrance or exits where required, and closing again by their own elasticity. There is just sufficient room inside for the mother-mouse and her blind and naked offspring, whether they number four, eight, or even nine. This nest is suspended at some little distance—about half a foot—above the ground, several stems being incorporated in its walls to give it stability, or it may be lodged between the stem and leaf of a thistle, or a knapweed, in blackthorn bushes or broom. The bed is made of split leaves of corn or grass. The nests

are not always so tough as that described by White, which "was so compact and well-filled that it would roll across the table without being discomposed, though it contained eight young." Several litters are produced throughout the year, varying in the number of young from five to nine ; and one might expect that the species would be represented by individuals as numerous as those of the House Mouse. It must be remembered, however, that the diurnal habits of the Harvest Mouse and its methods of feeding expose it to the attacks of the larger birds ; whilst the smaller carnivorous beasts do not neglect it. When the corn is cut the Harvest Mouse is often carried in the sheaves to the barn ; in that case it spends the winter there, and does not go to sleep. It is considered that the modern reaping machine has caused a great reduction in its numbers.

Until about December the young of the year resemble the House Mouse in colour, and may easily be mistaken for it ; then from the hind quarters forwards they begin to assume the redder tint. As the adult Harvest Mouse weighs only about a sixth of an ounce, it is not surprising that it should be able to sit on an ear of corn to which its capable little hands and prehensile tail have enabled it to climb with ease. But the familiar name must not delude us into supposing that it is only found in or about cornfields. It is also a denizen of the tall, rank herbage along ditches and untrimmed hedgerows. In winter it is frequently found about the lower parts of wheat and oat stacks.

Where the Harvest Mouse occurs it may be watched at close range by the quiet observer. Though as a rule timid and gentle in demeanour, it becomes at times savage and cannibalistic. It lacks the offensive odour of the House Mouse. Its voice is of a low chirping character, and has been likened to that of the wren.

With a more intimate knowledge of the structure of the

various species of Mice, it has been found necessary to break up the old Linnean genus *Mus* into several smaller genera. In this process our little Harvest Mouse becomes the sole British representative of the genus *Micromys*.

Wood Mouse (*Apodemus sylvaticus*, Linn.).

An alternative name for the Wood Mouse is Long-tailed Field Mouse, and but for the fact that Linnæus dubbed it *Mus sylvaticus*, it would be better to adopt Pennant's designation, for it is much more an inhabitant of the field, the hedgerow, and the garden than of the wood. It is, indeed, the cause of something approaching despair to the keeper of the kitchen garden ; for this is the miscreant that ploughs up and eats the newly sown peas that have not been rolled in red lead or soaked in paraffin. He has also a great fondness for strawberries at the moment they have become ripe.

The Wood Mouse is about three and a half inches long from the long snout to the base of the tail ; and the tail by itself falls only a very little short of that length. The fur on the upper parts is a dark yellow-brown ; the under parts white. In adults the line of demarcation is always distinct. There is a spot of buff or orange on the chest whose development in certain local races has enabled recent systematists to make five species out of this one. It has large and prominent dark eyes—for it is chiefly of nocturnal habits—and its long oval ears have the inner margin turned inwards at the base. The tail is dark brown above, and whitish below. It is the commonest of the British mammals in country places, but less frequent in Ireland. It is common in Europe as far north as Sweden and Norway.

As a rule it constructs its burrows underground or under the roots of trees, and here it stores up great quantities of nuts, haws, grain, and smaller seeds for use in winter, when it becomes inactive, though it does not really hibernate. But if

there is a house handy to which it can gain entrance in late autumn, it prefers to become the guest of those whose garden has been a boon to it through the spring and summer. We have had them spend the winter cosily in our rolled-up tennis nets, stowed away in a shed to keep them dry in the off-season; and as potatoes were stored in the same place they consumed a number of these. On several other occasions Wood Mice were detected attempting impudently to enter the dwelling house by the back-door. Once an entire family—mater, pater, and five active youngsters—succeeded in this enterprise; but they left incriminating evidence of their presence, though they were suspected of being ordinary House Mice. Accordingly a break-back trap, baited with cheese, was set one evening, and within half an hour its loud clap proclaimed its effectiveness. This trap appeared to show that the Wood Mouse is a simple-minded, unsuspecting creature, for it was reset with the same uneaten bit of cheese-rind for bait again and again, and no sooner was the trapper's back turned than another member of the family was secured. Seven times it sprang, and then its inaction appeared to be due to the fact that there were no more possible victims, for we saw no further traces of the mice. Its general resemblance to the House Mouse frequently leads to its being mistaken for that species.

There are several litters of young during the year, and these vary in number from five to nine—an alarming rate of increase; but, fortunately, the Barn Owl that hunts the hedgerow inch by inch, every evening, takes a heavy toll that keeps the numbers down. The Fox, the Weasel, the Hedgehog, and the Viper also do their part.

The Wood Mouse is a very active creature, running and jumping in zigzag fashion, climbing high in the bushes in order to obtain berries, leaping from considerable heights, and swimming well when occasion requires. Although an accomplished excavator, it often makes use of unmortared stone walls

House Mice.

A fierce battle between rival males.





Pl. 59.

Wood Mouse.
Apodemus sylvaticus.

G 91.

for its runs and stores. It wanders widely in its search for berries, bulbs, and grain. In the matter of berries, it is not the juicy pulp that it desires but the seeds, which it will carefully pick out. It prefers the larger grains from the cornfield to those of a grass-meadow. It is both timid and gentle in disposition, and on account of its short sight, it may be approached closely and caught with the hand.

Its stores of food are often communal, a colony of mice contributing, for it is not always of solitary habit. These stores are of the most varied character. Of the very miscellaneous items on its menu a few may be mentioned: leaves of clover and dandelion, with flower-buds of the latter, nuts of all kinds, apples, grapes, gooseberries, crocus and hyacinth bulbs (Millais says the Dutch were taught to multiply hyacinths by division of the bulbs through observing the effects of this mouse's attacks), acorns, rose and bramble seeds, slow-worms, eggs and—putty! It has been known to enter beehives, and not only to eat the honeycomb, but impudently to construct its nest there. Deserted birds' nests are often adapted to its use, either as a dining-room when seeking haws in the hedges, or as a permanent habitation, in this case roofed with moss.

The breeding nest is a globular structure of dry grass, and is usually built in a separate chamber of the underground run, but occasionally is on the surface or under a heap of hedge *débris*. Some of the burrows may extend as much as three feet underground.

Towards the end of last century, Mr. de Winton called attention to what was considered to be a new British mouse—the Yellow-necked Mouse (*Apodemus flavicollis*), distinguished from the Wood Mouse by its larger size, the head and body measuring four and a quarter inches, and the brown spot on the chest commonly found in the Wood Mouse developed into an orange cross whose arms are connected with the upper side

coloration—described as golden brown. This is a feature that at once attracts attention where this form occurs ; but there is another distinction out of sight—there being three additional bony joints in the tail, that is thirty instead of the twenty-seven in the tail of an ordinary Wood Mouse. Whether it is a really distinct species or the typical form of the Wood Mouse is at present open to question. It is found chiefly in the southern and eastern portions of England, but its distribution also includes Northamptonshire, Herefordshire, and Northumberland.

Other local races have been distinguished also as distinct species or sub-species under the name of Hebridean Field Mouse (*A. hebridensis*) with the white of the under parts tinted with buff ; Fair Isle Field Mouse (*A. fridariensis*), like the Yellow-necked but without the collar ; St. Kilda Field Mouse (*A. hirtensis*) with brown under parts ; and Bute Field Mouse (*A. butei*), darker, with shorter tail and ears.

House Mouse (*Mus musculus*, Linn.).

The most familiar, the most widely distributed and most numerous of the mammals of our country, the Common or House Mouse, stands in little need of nice description. Although of a timid and retiring nature, it can on occasion exhibit not only bold familiarity, but actual friendliness to mankind to which it has been attached for ages, preferring to live in palace or hovel with human beings to the open-air life of woods and fields. Not that he is not to be found in the open air ; but then it is mostly in the immediate neighbourhood of a house, where he can make his runs in ricks of corn—mountains of food. It is this easy method of despoiling man of his goods that caused the Mouse in ancient days to attach himself to the huge creature that is so impotent in ridding himself of small adversaries. The domestic Mouse is considered to have had its home, its

place of origin, in Asia, whence it has spread to every part of the world where man has gone. In most cases, it may be presumed with safety, it has travelled cosily stowed away in his stores and merchandise, so that as soon as the human migrant has built himself a home he finds that the Mouse is in occupation, and demanding a share of his food. In spite of all his serious depredations, our literature teems with evidence that the victim has always retained some kindly feeling for his pretty four-footed oppressor.

For the sake of uniformity, let us say that the head and body of the House Mouse measure a little more than three and up to four inches, and the tapering, flexible, and sparsely haired, scale-ringed tail may slightly exceed that measurement. It has a pointed snout, the bright, bead-like eyes are black, the large, sensitive brownish ears are nearly half the length of the head, and the soft, brownish-grey fur is only a little paler on the under parts. Outdoor specimens are often more yellow-brown in coloration. As compared with the Wood Mouse we have this more dusky and uniform coloration, shorter whiskers, smaller eyes, stouter and less flexible tail, and shorter legs. The thumb of the hand is reduced to a mere tubercle.

It is very active and silent in its movements, emerging from a tiny hole in floor-board or skirting and gliding without sound over the floor, ascending with ease table-legs or walls, and then, if alarmed, springing with a prodigious leap back to its hole. Concrete floors will not suffice to keep it out of a house, for it will climb the outer walls and enter the upper windows, thence making itself secret ways to the lower floors behind woodwork or plastered walls, till it reaches the kitchen, the larder or the storeroom. Though it shows by its preferences that its natural rôle is that of grain thief, it will eat any kind of human food and much besides : in a word, it is omnivorous.

Its great success as a species is due to this adaptability and to its astonishing fecundity. It produces four or five litters

during the year, each consisting of five or six, or even up to twelve, blind and naked young which develop so rapidly that in a fortnight they are capable of independence. At the age of six weeks they may begin to breed.

The House Mouse exhibits a considerable range of variation in colour, both darker and lighter than the type, and many of these variations have been bred from and their peculiarities perpetuated and accentuated in confinement as "fancy" mice. Of these the most familiar are the White Mice, really albinos with pure white fur, pink eyes, feet, and tail. There are also dark, nearly black variations, and spotted examples. Sometimes one is surprised at night to find that the house is tenanted by a musical mouse that runs up the scale in what appears to be an attempt at a little song. It has been ascertained, however, that these so-called singing mice are afflicted with a form of asthma, and the supposed vocal efforts are merely the manifestation of their physical trouble. We have had experience of musical mice in another way. For several nights in succession weird sounds came from the pianoforte which suggested that fairies were using it as a harp, twanging the wires instead of striking them with the hammers. An examination of the interior seemed to indicate the actual performer, for a little pile of Spanish nuts, stolen from the table, was discovered inside; and the twanging of the notes was caused probably by the mouse climbing them. A trap baited with a shelled nut put a stop to these performances. Bateson mentions several cases of hairless Mice, except for a few whiskers.

A local race of the House Mouse found in St. Kilda is sometimes dignified with species rank under the name of *Mus muralis*. Its distinguishing features include less slender feet and tail, and slight peculiarities of the palate.



House Mouse.
Mus musculus.



P., 61

Alexandrine Rat.
An alien stowaway from North Africa.

G 95.

Black Rat (*Epimys rattus*, Linn.).

Not many years ago a good deal of modified regret was expressed because it was thought that the Black Rat—the real old British Rat as it was called—was being exterminated by that vulgar upstart the Brown Rat—the Hanoverian or Norway Rat. These laments were mainly called forth by its comparative scarcity in old London warehouses where it had formerly been very numerous. One would have thought it a matter for rejoicing that there was a possibility of our having only one species of the rat pest to contend with instead of two. The disappearance of the Black Rat was remarked by Pennant as far back as 1778. However, later observations tend to show that the Black Rat is far from being extinguished even in the City of London, where the old type of warehouse is being rapidly replaced by ferro-concrete erections with carefully trapped drains. The intelligence of the Rat is equal to little impediments of that sort, and if it cannot get in by way of the basement it can climb walls and enter by the attic windows.

On the score of sentiment we need not distinguish between the Black Rat and the Brown. They are both Asiatic aliens, though the Black Rat had been settled here for several centuries before the Brown Rat followed in his tracks. Nothing definite is known as to the date of his arrival. Geologists assure us that he was not among the indigenes, for even the most recent strata yield no remains of his bones or teeth. He is known to have been on the other side of the dividing Channel in the thirteenth century, and to have reached England soon after, and quickly to have become a nuisance. He had a clear run of over four hundred years in which to occupy the most remote portions of the island, before he had to meet with keen competition in the form of the Brown Rat. He reached Ireland in the twelfth century, if not earlier.

The Black Rat is of more slender proportions than the better

known Brown Rat, and much smaller, the dimensions of the head and body being about seven inches, whilst the scaly-ringed and almost hairless tail is more than eight inches. The long, pointed snout projects far beyond the short lower jaw; the whiskers are long and black. Though presenting the appearance denoted by its popular name, the glossy blue-black fur has a good sprinkling of grey on the upper surface, whilst below it is dark grey. The large, thin ears are naked, and about half the length of the head. The feet are pink, with scale-like rings on the underside of the digits and five pads on the sole. The thumb of the fore feet is reduced to a mere tubercle.

Although the Rats have much to do with garbage and offensive matters, they take the greatest of care to maintain their own cleanliness and a spruce appearance, spending much of their time in cleaning their fur and paws. One of the reasons for regretting the possible extirpation of the Black Rat by his more pushful relative, was, no doubt, his less ferocious ways and well-known milder disposition—a trait which is obvious to any one who has handled the domesticated albino, or White Rat, which is generally considered to be of this species.

Where—as in India—the Black Rat lives a more out-of-door life, it climbs trees and mostly makes its nest in them. With us the doe collects a good quantity of suitable materials—rags, paper, straw, etc.—and constructs a roomy nest which she uses for successive broods, which come at short intervals. Seven or eight is the usual number for a litter, and there are five or six broods in a year.

In the matter of food, both the Rats are omnivorous, and it is, therefore, useless to attempt to give a list of substances acceptable to them. Fish, flesh, fowl, or vegetable, crustacean or mollusc—anything that can be digested—is eaten by them; and if all else fails they will eat their own kin. In this matter

P. 62.



Black Rat.

THEY'S TATTOO

690.



the Brown Rat, from his superior size and ferocity, has the advantage, as is emphasised by an incident told by a professional rat-catcher to Frank Buckland. He said that having had a successful haul in infested premises he had turned all his captures both Black and Brown into a large wire cage, intending to have a little sport next day with a few cronies and a terrier or two. To his astonishment next morning all the Black Rats had disappeared and only the Brown—or some of them—remained.

A sub-species, the Alexandrine Rat (*Epimys rattus alexandrinus*), with brown back and dusky underside, is frequently introduced with shipping from North Africa, and has been recorded from Lundy Island and Shetland. Another sub-species, the Tree or Roof Rat (*E. rattus frugivorus*), common in the Mediterranean region, often appears in our ports. It has long, soft and dense fur, of light grey or brown on the upper parts and whitish below (pure white to pale yellow), and the feet usually white above.

The Black Rat is more of a climber than a burrower ; more cleanly in its feeding than its brown rival. The pink-skinned young are born without fur, sight, or hearing.

Brown Rat (*Epimys norvegicus*, Erxleben).

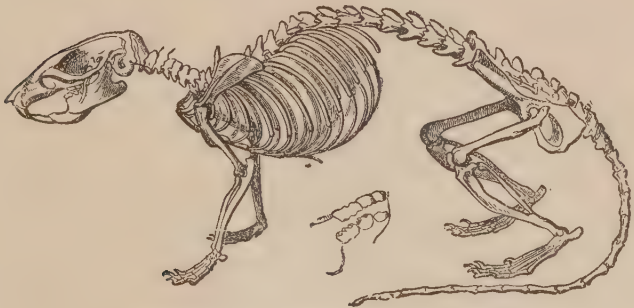
The Brown Rat still has two alternative names applied to it, though the inappropriateness of one was shown by Pennant more than 150 years ago. These names are Norway Rat and Hanoverian Rat. Pennant does not mention the second, but of the first he says that the Brown Rat is quite unknown in Scandinavia and is not mentioned by Linnæus. The name Hanoverian appears to have been given to it because it was believed to have made its entry into England with George I. Writing in 1776, Pennant says : " This animal never made its appearance in England till about forty years ago." Recent researches into its distribution make it appear that the species

originated in Trans-Baikal, whence it has spread westwards, even to America by way of the British Isles. Both species hit upon an improved method of extending their range over the earth. The old-fashioned natural way for mammals to spread was for a few adventurous individuals to make food-finding excursions beyond the district in which they were born; but climate, mountain ranges, broad rivers or seas often checked further progress. The Rats discovered that by keeping close to man they were always in the neighbourhood of food, whether intended for himself or his domestic animals; and even these tame creatures would at times serve for the Rats' meals. So when they found man loading ships with grain and other desirable food they decided to go with him. Often they contrived to get into his bales of merchandise and so conveyed to the hold. If not, there were always mooring ropes which served as bridges from the quay to the vessel. And so they got themselves conveyed in comfort, sure that wherever the goods went there would be settlements of their biped friends to house them and serve their ends generally. Now, wherever man has established himself, you are almost certain that the Rat is close at hand.

Mr. A. W. Rees, in his interesting "Creatures of the Night," has summarised the chief characteristics of this species in a paragraph. He says: "Brown Rats are an insufferable nuisance. There is no courtesy or kindness in the nature of the Rat; no nesting bird is safe from his attacks, unless her home is beyond his reach in some cleft of a rock that he cannot scale or in some fork of a tree that he cannot climb. He is a cannibal—even the young and the sick of his own kind become the victims of his rapacious hunger—and he will eat almost anything, living or dead, from the refuse in a garbage heap to the dainty egg of a willow-wren in the tiny, domed nest amid the briars at the margin of the river."

As compared with the Black Rat he is more heavily built,

and the combined length of head and body is eight or nine inches, whilst the thicker, scaly-ringed tail is only equal to, or less than, the length of the body alone. His head is proportionately shorter, with blunter muzzle, much smaller ears and more prominent though smaller eyes. The fur on the upper parts is grey-brown with a tawny tinge, and dirty white on the under parts. The ears, feet, and tail are flesh-coloured. It sometimes occurs with black or blackish fur, and is then frequently mistaken for the Black Rat ; but the relative length



Skeleton and Molars of Brown Rat.

of tail to body is a superficial character by which they can be separated at once. There is a black race of this species on the east coast of Ireland to which some authors have given the distinctive name of *Epimys hibernicus*. It appears to have extended its range from Ireland to the Hebrides. In one form or other the Brown Rat has extended to nearly every part of the British Islands and their islets.

The Brown Rat becomes a parent at the age of six months, and produces four or five litters in a year. Ordinarily these consist of from four to ten blind, deaf, and naked young ; but much larger litters are on record, the highest of which we have

seen a note being twenty! Sometimes the young grow up hairless or blind. Some years ago we disturbed a nest in the garden from which issued half a dozen young Rats about four inches long (head and body), all blind. They moved about in a very uncertain manner, and were easily despatched. Similar cases have been recorded. At the meeting of the Zoological Society in December, 1902, a hairless Rat was exhibited on behalf of Mr. G. A. Doubleday, one of three captured at Leyton, Essex, in the same condition. The skin, which was slate-coloured, was wrinkled into folds all over the body. Millais mentions a hairless Rat with yellow skin.

In the country—where it is known as the Barn Rat—the Tawny Owl and the Weasel are the farmer's best friends as Rat-catchers, though they do not always get the consideration that their services merit. The Weasel tribe are admittedly also destroyers of poultry; but the depredations of the Rat in this connection are much more serious. They do much mischief in chicken-runs, and being good swimmers and divers, even ducklings afloat are not safe from them. If a pair of ducks have made their nest on an island for safety, rats will swim to it and feast on the eggs, or, should these be hatched, kill the ducklings and eat them. It is more than probable that much of the destruction of pheasant and partridge eggs debited to the account of the Hedgehog, has really been carried out by the Rat. Jordan ("Forest Tithes") says he has known a Rat or Rats take a dozen eggs from a wild duck's nest and bury them in the soft peaty bottom of a moorland runnel, close to the nest. "I traced the whole proceeding and dug the eggs out with my fingers."

It does not matter where it is living, in town or country, the Rat is equally destructive to property and live stock. We have known them to destroy a crop of garden peas by ascending the pea-sticks, night after night, lacerating all the pods that had fair-sized peas within, and eating out every one. They skulk



Pl. 64.

Brown Rat.
Rattus norvegicus.

1/100.



Pl. 65.

Water Vole Swimming.

H 101.

This fine swimmer is making for his burrow in the bank.

along the hedgerows until they reach the "cave" where the farmer has stored his mangolds to secure them from frost. Scores of them will burrow through the cover of earth and eat their fill of the succulent roots. Well is it for the farmer if the Weasels have not been exterminated on his land, for they are the most efficient guardians of his hoard. Hawks and Foxes render similar service if the Rat wanders out into the open moorland ; but the Rat rarely ventures far from cover of some sort.

There is a melanic or black form of the Brown Rat which is frequently mistaken for the true Black Rat, though the more bulky build and blunter muzzle should show the difference at sight. First recorded from Ireland in 1837, it was considered a distinct species under the name of the Irish Rat. Its fur is uniformly dusky above and below, and the skin is of similar hue. The variation is now known not to be confined to Ireland, but to occur in many parts of England and in the Outer Hebrides. White, fawn-coloured, and pied variations also occur.

The versatility of the Brown Rat is such that it would be idle to attempt any description of its habits. Every one knows at least some part of the story, and the whole of it would require a book. It is the most powerful natural enemy that civilised man has had to contend with, for it attacks him in his own strongholds, spoiling and wasting his food stores and destroying his property in general. There was a time when it could be looked upon more as a commensal because of the valuable scavenging work it performed ; but since man has learned that it is safer to attend to this work himself the Rat has become a mere parasitical nuisance. Sir J. Crichton-Browne has estimated the annual loss to this country through the depredations of Rats at £15,000,000 (pre-war figures, 1908).

The Rat is so thoroughly omnivorous that it would be equally absurd to attempt a list of its food : there is nothing

that can be eaten that the Rat will not eat. Therefore, there is no possibility of starving him out. Rat-killing campaigns that do not cover every square yard of the country can only have the effect of temporarily mitigating the nuisance ; for the Rats' fertility is so great and so rapid that the loss of nine-tenths of a generation is quickly made good. A continental statistician has worked out the theoretical progeny of a single pair of Rats after ten years as reaching the appalling figure of 48,319,698,843,030,344,720 ! Of course, there is no great value in such a calculation, for it proceeds upon the assumption that every individual lives to become a parent, whereas in fact the mortality in all creatures of such fecundity is enormous, and there are few if any more survivors this year than there were last year. In other words, the great fertility of a race only suffices to make up the wastage from enemy attacks. But the figures serve to show what might happen if the natural control by Weasels, Stoats, Hawks, and Owls were suspended for a short time. But Rats are disseminators of bubonic plague with the aid of their special species of flea.

Water Vole (*Arvicola amphibius*, Linn.).

In certain directions it appears that failure is the lot of those who have spent the greater part of their lives in trying to spread enlightened views as to the true nature of our native animals and plants. Among a number of such failures two or three may be briefly cited here : you cannot persuade a countryman that a slow-worm is not a snake, that all snakes are not poisonous and to be killed at sight, and that the comparatively inoffensive rodent now to be described is not a rat and of rat-like nature. The name of Water Rat is general as a true folk-name.

The Voles are of heavier build than the Rats, the head is shorter, thicker, and the muzzle rounded instead of being



Pl. 66.

Water Voles fighting.

Arvicola amphibius.

H 102.



Pl. 67.

Young Field Voles.

Average litter of five; eyes still closed.

H 103.

pointed ; the limbs are shorter and the hairy tail is not much more than half the length of the head and body. The eyes are small and short-sighted, and the small round ears scarcely project from the surrounding fur, though when listening intently the Vole erects them and makes them more conspicuous. Linnæus, following Ray, described the Water Vole as having webbed feet, but this is incorrect, though the toes of the hinder foot are connected at their base. They are naked and pale pink beneath, with five rounded pads, but above are clothed in stiff hairs. The thick, long, glossy fur is of a warm reddish-brown above, sprinkled with grey, and on the under parts yellowish-grey. This applies chiefly to the male ; the female is slightly smaller than her mate, is less bright and more greyish-brown in her coloration. The average length of head and body is seven and a half inches, and of the tapering, ringed tail about four and a half inches. It sometimes occurs with black fur, especially in East Anglia and Scotland ; and these examples are usually reported as the Black Rat. Some modern authorities recognise it as a sub-species (*reta*).

Although it has not the webbed feet that Ray attributed to it, its swimming and diving powers are of a high order. Often in walking near a stream or pond, the loud sudden “plop” as it drops into the water is our first intimation that the Vole is near. We may occasionally track his course under water, but as a rule he at once disappears into his burrow in the bank, sometimes by an underwater entrance, and may regain the bank by an upper exit. These burrows, in which the Vole spends most of the daytime, often occasion considerable damage, as to the dykes in the Fenland, and where ponds have been constructed by artificial banking. Otherwise, the Water Vole must be pronounced an entirely inoffensive rodent, in spite of the libels that accuse him of capturing waterfowl and fish for which he is unfitted. He has been seen grubbing among the mud at the bottom for caddis-worms and other insects,

freshwater snails and the like ; otherwise his food appears to be restricted mainly to the stems of horsetails and the succulent grasses, flags, loosestrife, and sedges that grow along the banks. Mr. A. Patterson says that in East Anglia he eats dead fish and living swan-mussels—also crayfish ; but prefers the stems of the succulent grasses that grow in shallow ditches. That he is not a strict vegetarian appears to be proved by the fact that he is sometimes captured in rat-traps that have been baited with meat. St. John says that in spring, before the grasses are much grown the Water Vole feeds largely upon toads, rejecting the feet which it bites off and leaves in little heaps. We have been assured by a Surrey woodlander of long experience and an intelligent observer, that he has known the Water Vole on several occasions to indulge in very young chickens ; but he admits this is a very rare occurrence and that it scarcely detracts from the Water Vole's reputation as a vegetarian.

On the flanks, about halfway between the shoulder and the tail, will be found a pair of wrinkled glands which secrete a greasy matter with a musky odour. These are present in both sexes. Though the odour probably protects the Water Vole from some animals that might otherwise prey upon it, it does not appear to be objectionable to the Heron, the Owl, or the Stoat. When, to escape from real or fancied danger on land it suddenly dives into the water, it is not always to safety, for pike, large trout, and eels have been observed to seize them.

The Water Vole does not hibernate ; but it has been said to lay up considerable stores for the inclement season when food will be scarce and difficult to find. These stores consist of nuts, beechmast, acorns, and the creeping underground stems of the horsetails. During the milder nights that come in winter he issues from his chamber in the bank and feeds upon young willow shoots ; and though mainly a nocturnal animal will often take advantage of the higher temperature at

midday during the winter. It is often found in fields far away from any water.

The female constructs a thick-walled globular nest of reeds and grasses in the chamber under the bank, or in a hollow willow or a bird's nest, and there brings forth her litter of about five (two to seven) naked and blind young. The process is repeated three or four times during the season.

The Water Vole is generally distributed in Britain, but does not occur in Ireland, or the Scottish islands ; nor is it known outside Britain.

The surface of the molar teeth in all the Voles presents a pattern of alternating triangular prisms. In the Water Vole and the Field Vole these teeth are not rooted in the jaw ; in the Bank Vole they are in the adult.

In addition to the definitely black sub-species (*reta*) referred to above, the southern brown sub-species occasionally throws up black, pied, or albino variations.

Field Vole (*Microtus agrestis*, Linn.).

To country folk the Field Vole is known generally as the Short-tailed Field Mouse, to distinguish it from the Wood Mouse which is also the Long-tailed Field Mouse. Being different in organisation from the true Mice the attempt was made in natural history works many years ago to substitute the name Vole for these blunt-muzzled Rodents. Recently, after about a hundred years' use of the word Vole in all the works on mammals, Mr. Barrett-Hamilton has objected to it, at least in connection with the present species, on the ground that Field Vole is a duplication, the word Vole meaning "field." This would be almost as bad as Mr. Barrett-Hamilton's own use of such scientific names as *Pipistrellus pipistrellus*, *Barbastella barbastella*, *Martes martes*, and *Capreolus capraea*, which are duplications in the same language ! In East Anglia this species is the Marsh Mouse, and in Surrey Dog Mouse.

The general appearance of the Field Vole is so different from that of a Mouse that it should be obvious at a glance that they are not very closely related. The general stumpy form with the blunt oval outline of the head, the short, round ears just protruding from the reddish-brown fur, and the short, rather stiff tail, are points sufficient to distinguish it from either of our Mice. The colour mentioned refers to the upper parts ; on the under side the fur is greyish-white. The hind feet have six pads on the under surface as compared with the five of the Water Vole. The length of head and body is about four inches, and of the tail only an inch and a quarter, that is, about a third of the body length.

The chief resorts of the Field Vole are meadows and damp pastures, but it will also be found in gardens, orchards, and plantations, doing enormous damage in every place, for its food is mainly of a vegetable character. It must, however, be placed to its credit that it catches and consumes large numbers of insects, among them the destructive Larch Sawfly (*Nematus erichsonii*). It has extensive underground stores where it lays up food for the winter ; but it is a mistake to say, as it has been said repeatedly, that the underground burrows include its summer nest. These burrows connect with a network of above-ground runs through the grass and herbage, with occasional holes that enable the Vole to bolt underground. These runs are made without disturbing the grass blades, which cross above them and so enable the Vole to run or creep along them without being seen by the hawk that circles high overhead. He is not so successful in eluding the Owl, who hunts much nearer to the ground and with the Weasel keeps a salutary check upon its increase. Beside a rank tuft of grass along one of these runs the female makes her nest, roofed with a circular dome of grass blades divided longitudinally and plaited and felted. It very much resembles the ground-nest of the Humble-bee, but on a much larger scale. There is nothing

Pl. 68.

Nest of Field Vole.



The dark run at left connects with the nest at right.

Pl. 106.



to distinguish it from its surroundings, so that only an eye trained to find it would see it. It may be detected by the finer character (due to shredding) of the grass. The parent enters or emerges from any point under the edge of the dome, and in the case of our uncovering the nest will at once bolt, leaving her five youngsters at our mercy. This we have found to be a characteristic callousness on her part. We have frequently torn off the roof of such nests suddenly, but have only been able to catch sight of the rapidly moving mother and trace her for a short distance along a run, so unhesitating and rapid was her flight. Like all our Rodents with the exception of the Hares, the young are naked and blind at birth, and there may be five, six, or seven in a litter. Those shown in the photograph, though their eyes were not open, had beautiful coats of short fur. There are several litters in a season.

In those districts where the over-zealous efforts of the game-keeper have resulted in the partial extermination of the Weasel and the Owls, the increase of the Field Vole is so enormous and so rapid that they have at times become a plague. Crops are cleared from the fields, young trees in plantations destroyed by thousands, and even newly-sown cornfields rendered unproductive by every seed being eaten. In the New Forest and the Forest of Dean great loss has been sustained at various times by their severing the roots of young trees that crossed their runs, and by their gnawing the bark of the young trunks. The most effective of the plans adopted for lessening their numbers was by sinking pits a foot and a half deep, wider at the bottom than at the mouth, into which vast numbers fell and from which they could not escape. More recently the South of Scotland suffered from a plague of "mice" that ate up everything in the fields, inflicting such serious loss to agriculture that a Government Committee was appointed to inquire into it, and it was found that the chief culprit was the Field Vole. Fortunately, when things were at their worst, a

vast number of Short-eared Owls appeared upon the scene and feasted royally until there was scarcely a Vole to be found. It was found that the enormous increase in the numbers of the Voles was directly due to the warfare waged by keepers on Weasels and Owls. Matters are better, perhaps, to-day; but there are still too many keepers who destroy as vermin the very agents that keep down the real vermin. We still need a few landowners of the temper of Charles Waterton, who threatened to strangle his keeper if the latter molested a certain pair of Owls.

It was also shown at the Vole Committee of 1893, referred to above, that the Rook destroys great numbers of Field Voles—not only adults that chance to cross the fields where the Rooks are digging cockchafer grubs, but that they systematically search for the nests and eat the young.

As in the case of the Wood Mouse, there are several local races of the Field Vole that have arisen in the islands of the Orkneys and Hebrides, which have been elevated into distinct species by some recent authors. Thus, there are recognised the Hebridean Vole, the Orkney Vole, the Sanday Vole, and the Westray Vole. Mr. Barrett-Hamilton regards the true *agrestis* of Linnæus as not occurring in this country, where it is represented by several sub-species. The Common Field Vole described above, he says, is a distinct species, the *M. hirtus* of Bellamy. This, which he describes as “a newer, smaller form,” he says “has replaced an older, larger *M. agrestis*, the latter now confined chiefly to northern regions, and with isolated southern colonies on the mountains.” Seeing, however, that most modern authorities agree in retaining the Linnean name, we have considered it advisable to do so also.

The form that Barrett-Hamilton recognises as *M. agrestis* and calls the Northern Grass Mouse, is, so far as Britain is concerned, represented only in Scotland and its western islands by five sub-species which he names as under:—



Pl. 70.

H 108.

Orkney Vole.
Microtus orcadensis.



Macgillivray's Grass Mouse (*M. agrestis macgillivrayi*), a rich buff-coloured form with thin fur, restricted to Islay, where it is rare.

Hebridean Grass Mouse (*M. agrestis exsul*), common on several islands of the Hebrides. Distinguished from the Field Vole by its much larger size and duller brown colour.

Eigg Grass Mouse (*M. agrestis mial*) restricted to the island of Eigg. Differs from *M. a. exsul* in its shaggy coat of abundant long hairs.

Highland Grass Mouse (*M. agrestis neglectus*) found on the summits of the highest Scottish mountains. It is larger than the Field Vole, with thicker fur and darker, browner upper side. It differs from *M. a. exsul* in the simpler character of the first molar tooth.

Muck Grass Mouse (*M. agrestis luch*), of which only three specimens have been taken, all on the island of Muck. About the same size as the Field Vole, it has a buff underside.

Orkney Vole (*Microtus orcadensis*, Millais).

So far back as 1805 the Rev. George Barry, in his "History of the Orkney Islands," mentions a rodent that was known locally as the Vole Mouse, which he believed to be the same as the *agrestis* of Linnæus. He says it "is very often found in marshy grounds that are covered with moss and short heath, in which it makes roads or tracks of about three inches in breadth, and sometimes miles in length, much worn by continual treading, and warped into a thousand different directions."

Towards the end of last century Mr. J. G. Millais obtained specimens, and on a critical examination found that they differed from the known forms in several details of skull structure and in the folds and angles of the teeth, sufficient in his opinion to constitute a new species, which he called *Microtus orcadensis*. It is larger than the Field Vole, with a longer and slightly broader head.

It was found subsequently that specimens from different islands in the Orkney group showed differences due to their segregation over a long period, and they have consequently been distinguished as five sub-species. These differences are minute, and it would be wearisome and out of place in a popular work such as the present to detail them. Generally speaking, they are much alike, and their habits are practically identical, so far as at present known.

The runs are a conspicuous feature of the islands, among the heather and the rough vegetation of the fields and hillsides, running along the surface and at intervals entering tunnels about two and a quarter inches in diameter—just sufficient to clear the spread of the Vole's whiskers. Their nesting places, like those of the Mole, are under small mounds connected with a network of runs. The nest itself is made of grass and roots in a rounded chamber, where at intervals during the spring and summer several litters, varying from three to six, are produced. Before they are three weeks old they are capable of independent existence, but for a time are still guarded by the mother.

The Orkney Vole appears to be specially fond of the roots of Heath Rush (*Juncus squarrosus*), but also feeds on grass and the crops in cultivated fields to which they can gain access. Mr. Millais found that in cold weather his captive Voles became inactive. It has many enemies to hold its increase in check, for every bird and beast large enough to capture it will eat it readily.

Bank Vole (*Evotomys glareolus*, Schreber).

There can be little doubt that in many places the Bank Vole has been mistaken for a bright variation of the Field Vole. Its habits are much the same, except that it haunts the hedgerow and wooded country rather than the open fields. As to the differences between the two species, the Bank Vole's head and body measurement is only three and three-quarter inches against

four inches in the Field Vole, but its tail is actually (not merely proportionately) longer, being nearly half the length of head and body, and ends in a pencil of hairs. The ears and feet are proportionately larger, the former also being more oval than round. It further differs from the other Voles in the fact that the molar teeth become rooted in the jaws of the adults. The fur of the upper parts is a bright chestnut-red or Vandyke brown, excepting the hairy tail, which is black above. The under parts, including the lower side of the tail, are whitish varying to yellowish or even buff. The redder tint causes this species frequently to be styled the Red Vole. It has pink lips, and grey feet. Whiskers about an inch long. Black and albino varieties have been recorded.

It was considered formerly to be a rare British species, but more discriminating attention to the smaller mammals in recent years, and the wider adoption of trapping by naturalists, have tended to modify that view. It is probably more local, but it appears to be widely distributed, and to occur as far north certainly as Moray and Elgin; but it is not recorded from Ireland, Man, Hebrides, or Shetland. A local race is found in Skomer Island, and has been named *E. skomerensis*. When Yarrell detected the Bank Vole as a distinct species in 1832, it was considered to be of very restricted range in this country. The discovery was made in Essex, but it was soon reported from Hertfordshire, Middlesex, Berks, and Cambridge, and more recently from Oxfordshire, Warwickshire, Shropshire, Worcestershire, the Lake District, Northumberland, Inverness, etc. It is restricted to Europe in its wider range. In this country it does not appear to occur at elevations of more than about 700 feet.

The Bank Vole is much more agile than the Field Vole, and not so much given to burrowing. It may be seen abroad in sunny situations at any time of the day, preferring warm, dry places, yet frequently to be found in wet places. It is a good swimmer and diver. It constructs shallow runs in the earth of

a roadside bank or hedgebank. These have many entrances and exits above and below, as shown in our photograph ; some of the passages connecting with the top of the bank, others enlarging into blind chambers. Its food includes herbage, roots, bulbs, fruits, and seeds ; it appears to be particularly fond of turnips. In spring it has been observed climbing rose and hawthorn bushes in order to nibble the new leaves, and in autumn to obtain the hips and haws. It also seeks nuts, berries, the grain of wheat and barley, and the seeds of smaller grasses. Insects, snails, and even small birds are eaten by it, and the entrance to its burrows frequently gives evidence of the variety of its food. It has been known to eat the unpalatable Shrew that it has killed, and even to given way to cannibalism. In Scotland it is accused of eating the shoot-buds of young conifers, especially of larch, and gnawing the bark from branches.

In this country it is occasionally captured in the act of robbing household stores, but in more northern regions, as in Norway and the Yukon, it is a constant inhabitant of houses. It is not one of the hibernating species, therefore as a rule it does not lay up stores ; but Mr. Douglas English records the digging up of five Bank Voles with a store of ninety-three sound cob-nuts.

There are several litters of three to six naked and blind young during the year, produced in nests of grass, moss and wool, or feathers, usually placed above ground, sometimes in a bird's nest at some height above it. The males are very quarrelsome, and when fighting or pairing are very vocal, indulging in grunting squeaks.

Three geographical races or sub-species have been recognised by Barrett-Hamilton as distinct species under distinct names. These are Skomer Bank Vole (*Evotomys skomerensis*) from Skomer Island, off Pembroke ; Alston's Bank Vole (*E. alstoni*)

Pl. 72.



Retreat of the Bank Vole.

H 112.

Run continues from hole (left) under exposed root (right).



from the Isle of Mull; and the Raasay Bank Vole (*E. erica*) from Raasay Island, Skye. Barrett-Hamilton regards these as descendants of a former "Boreal" group of Voles, which have been supplanted on the British mainland by the competition of the Bank Vole.

Rabbit (*Oryctolagus cuniculus*, Linn.).

The Rabbits and the Hares being comparatively large and familiar members of our native fauna do not appear to stand in need of much space being devoted to them. Familiar as the two common species may be they require to be distinguished not only one from the other, but also from the two other and less familiar species, and in addition there may be a few facts of organisation and habit that are not well-known to all our readers. All members of the family Leporidæ, there are certain structural features in which they all agree in a general way. They belong to the section of Rodents known as Duplicidentata, because in the upper jaw there are always two pairs of incisors. All the other Rodents have only one pair, and they form the division Simplicidentata. The dentition of the Rabbits and Hares is therefore as follows: $i \frac{2}{1}, c \frac{0}{0}, p \frac{3}{2}, m \frac{3}{3} = 28$.

The ears are remarkably long and out of all proportion to the size of the body when compared with other Mammals. If laid forward over the face they reach nearly to the tip of the nose. The eyes are large and prominent and placed well to the sides of the head. The hinder legs are longer than the fore legs, and so greatly developed as to be the main propelling power. Instead of pads on the soles to protect the foot and legs from the jars incidental to hard running, the Leporidæ have all the feet covered beneath with a thick coating of hair which gives a firm grip either on hard rock or slippery snow. The tail is very short and turned up. The fur is of triple formation: there is a dense, soft, woolly underfur, through which push longer and stronger hairs and give the coat its colour, and a still longer but

much less numerous set, scattered among the others. The two longer sorts of hair are more or less ringed. The coat becomes thicker in winter.

They are sexually mature at a very early age, and often begin to breed before they have attained to full size. The females are distinguished by the form of the head, which is longer and more delicately modelled than that of the male. The males (bucks), too, are restless and quarrelsome. They are promiscuous breeders, and the entire care of the family falls upon the mother (doe).

Litters of Rabbits succeed one another rapidly between February and September; less frequently in the autumn and winter months. The litters vary from two or three to eight, the higher numbers being those of the warmer months. Young Rabbits are but sparsely clothed and are blind and deaf, the ears being closed and having no power of movement until about the tenth day. The eyes open a day later. In a few days more they can run, and make short excursions from the underground nest. Before they are a month old they are capable of independent existence. Until then the mother will defend them against all-comers, including the Weasel and Stoat, using her powerful hind feet against her adversary, and to good purpose.

The Rabbit is a much smaller animal than the Hare, greyer in colour, with smaller ears and feet, and the black tips of the ears so noticeable in the Hare, are in the Rabbit much reduced or altogether wanting. Its average weight and measurements are: weight, $2\frac{1}{2}$ to 3 lbs.; length of head and body, $16\frac{1}{2}$ ins., tail, $3\frac{3}{4}$ ins., ear, 3 ins., hind foot with claws, $3\frac{3}{4}$ ins. It also differs from the Hare in the structure of its heavier skull, its smaller eyes, shorter ears, and lesser specialisation of the limbs for speed in running.

It is believed that originally the Rabbit was a native only of the western parts of the Mediterranean region—where it still

teems—and to have spread northwards largely by human aid. It is known to have been introduced to Italy from Spain by the Romans, who are usually credited with having brought it to Britain. It is now thought, however, that we are indebted to the Normans for its presence. It was certainly here in the twelfth century. The name Rabbit is from the French, and originally indicated the suckling young ; the adults being known as Conies.

Although so famous as a digger of extensive underground dwellings, Nature does not appear to have specially built the Rabbit for this purpose ; but where the soil is light the efforts of many generations of associated workers have resulted in a system of burrows both extensive and complicated, with bolt-runs as emergency exits and stop-runs for nursery use. Although it prefers the light sand of the dunes covered with Marram-grass, or a sandy heath overgrown with furze and heather, it will on occasion drive its tunnels into firm loam or dry clay ; it has been known even to burrow deeply into a surface seam of coal. The fore paws are the principal burrowing tools, the loosened earth being thrown far back by the kicking of the hinder feet. Where stones come in the way that cannot be loosened by the paws, they have been known to be removed by the teeth. These tunnels are about six inches in diameter, increased locally to a foot to provide passing places. The residential quarters are always blind chambers leading from the main passages. The adult Rabbits do not indulge in bedding materials but rest on the bare soil. The does, however, make beds for their young by denuding their own under parts of fur. These tunnels are frequently made use of by other animals, if necessary, by enlarging the passage to admit their larger bodies. When Rabbit-earths are ferreted they sometimes yield more than Rabbits : a Fox, a Cat, a Stoat, with several Rabbits and Rats, have been driven out of the same earth.

Where the Rabbit finds the ground too hard or too wet, it

contrives to do without tunnelling underground, making runs under the heather, furze, or matted herbage. Such exceptions are known to sportsmen as Stub-Rabbits or Bush-Rabbits, in the belief that they are a separate species. Occasionally, too, the doe will follow the example of the Hare, and make a nursery "form" in fallow land or among the growing turnips.

The Rabbit is almost exclusively a vegetarian, its chief food being grass and the tender shoots of furze ; but in the vicinity of cultivated land they devastate the crops and inflict serious loss upon the farmer. The exception to a vegetable diet is found in its occasional indulgence in snails. Wherever there is sufficient food and his enemies are not too oppressive the Rabbit has extended his range to the most out-of-the-way corners of these islands. A century ago it was a scarce beast in Scotland, but it is now to be found in abundance up to the extreme north. It is found also all over Ireland. Its chief enemies, in addition to man, are all the members of the Weasel family, the Owls, and the Hawks.

Every one who has come across a party of Rabbits feeding must have noticed how conspicuous the white underside of the upturned tail makes them in flight. Wallace suggested that like the white patch on the hind parts of deer and antelope it served as "a signal flag of danger," a guide to the young and feeble to escape from danger by following the most vigorous seniors. This view has been strongly criticised, even ridiculed ; but the critics have not offered a better explanation of the upturned Rabbit's "scut." It must, however, be admitted that any explanation ought to fit the case of the Hare which often carries its tail with the white underside exposed, but is a solitary animal with no companions to follow it. On the sand dunes the Rabbit's coat renders it invisible through harmony with the sand.

In the ordinary way of life the Rabbit is a silent animal, except that he gives vent to low growls and grunts to express anger or

Entrance to Rabbit Burrow.

Bare slope in front formed of excavated earth.





pleasure ; but when terrorised by the imminence of attack by a Stoat the Rabbit finds its voice and gives utterance to a loud scream of agony. This has been referred to in the account of the Stoat (*ante*, p. 68).

Brown Hare (*Lepus europæus*, Pallas).

Although in general form and structure the Hare is similar to the closely related Rabbit, there are differences so great as to have induced recent systematists to put them into different genera ; and, even superficially, they are sufficiently unlike to enable country-folk to keep them distinct under different names. These differences are evident in the longer body, the great length of the hind limbs, the longer ears with their invariable black tips, and the tawny colour of the fur of the upper parts. To these distinctions they can add the patent facts that whilst the Rabbit is a sociable beast, associating in large communities, the Hare is as solitary and retired as a hermit.

There has never been any suggestion that the Hare's title to rank as a real native of Britain is open to doubt, for its name is Anglo-Saxon, and identical with that in use in Denmark and Sweden. It is widely distributed in England, Wales and Scotland up to about 2000 feet elevation ; but in Ireland (which has a separate species of its own) the Brown Hare is not a native. It has been a favourite animal of the chase from the earliest times of which we have records ; and our ancient sportsmen had age-names for it as for Deer. Thus, in its first year it was a Leveret, in the second year a Hare, and in the third a Great Hare. The male is distinguished as Jack-Hare, and the female as Doe.

The total length of the Hare is about twenty-four inches, to which the tail contributes three inches and two-thirds, and the head nearly four inches. The ears fall short of five inches. The weight averages about eight pounds. The tawny fur of the upper side is harsher than that of the Rabbit, which is due to

a predominance of the strong hairs of medium length described under Rabbit. The shoulders, neck, and flanks are of a ruddier hue than the back, and a ruddy band crosses the loins. The sides of the face, and the outer surfaces of the limbs, incline to a yellow tint. The underside is pure white except at the breast and loins where the ruddy tint is continued from above. There is a profusion of black and white whiskers, of which the white are the longer and as much as three and a half inches in length. The tail, which is carried curved up over the back or straight behind, is black above and white on the sides and below. The



Skeleton and Teeth of Brown Hare.

large, prominent eyes have a horizontal pupil. As it is almost impossible to come upon a Hare asleep, it was formerly believed that they have no eyelids and are compelled, therefore, to sleep with their eyes open. This, of course, was an "inexactitude" comparable to the belief in the Mole's lack of eyes and ears. The prominence of the dark eyes of the Hare, and their situation well to the sides of the head give him a wide field of vision. As regards sexual distinctions, the Jack-Hare has a smaller body, shorter head and redder shoulders than the Doe.

The Hare is not a burrowing animal, and does not seek refuge underground from his enemies, unless hard pressed,

when he may enter a Rabbit burrow temporarily. He relies upon his russet coat harmonising generally with his surroundings; and content with a slight depression among the grass known as a "form," he sits all day and surveys the landscape, ever ready to use his powerful limbs when his keen senses tell him there is danger near. At dusk he goes abroad to feed, and returns to the form at dawn. To break the continuity of scent, when he is leaving his form, and again when returning to it, he will suddenly turn at right angles to his former course and make a prodigious leap—fifteen feet or more—to the top of a bank, then take another long bound, perhaps into marshy ground where the scent will not lie, and repairing to the feeding-ground feel safe from being tracked by Fox or Polecat. He always adopts this leaping trick, also the plan of doubling on his track, which has been the admiration and vexation of the hunter from old times. Shakespeare has told at some length

"How he outruns the winds, and with what care
He cranks and crosses with a thousand doubles:
The many musets through the which he goes
Are like a labyrinth to amaze his foes."

As he courses across the fields you get the impression that he is longer than the measurement given above; the impression is due to the length of the hind legs extended in running, and from which he especially gets the advantage over pursuers when the course lies uphill. He is a good swimmer, and often crosses rivers in order to reach a better feeding-ground, to avoid pursuit, or to seek a mate. Hares have been known to cross the Trent in numbers, where it was two hundred yards wide, in order to reach a field of carrots on the further side; and Yarrel saw one cross an arm of the sea a mile broad.

The "form" is made in rank grass among thickets of gorse and briar, or in the open field where the ground is dry beneath it. It takes and retains the shape of the animal's body, and may be used for a long period. Here the doe brings forth her

litter of two, three, or four young—occasionally more. There is much variation in this respect. These are born with their eyes open, and a short furry coat, which however lacks the ruddiness of the adult. They are capable of using their limbs, and are so well advanced in development before birth, that soon each makes its own little form beside the mother's, and when a month old they are quite independent. When left alone on the form, whilst the mother goes off to feed, and anything alarms them, they cry "leek, leek." The adults pair promiscuously; and there appear to be three or four litters a year.

The Hare appears to moult twice a year—in early autumn and early spring; the former being the principal. Like the Rabbit, it is exclusively vegetarian in its feeding, including bark, grain, and roots as well as herbaceous plants in its bill of fare. It is very destructive to young trees in plantations, and the farmer and market-gardener suffer severely from its depredations among the crops of carrot, lettuce, turnip, etc. In the open country it prefers grasses of the genera *Poa*, *Festuca*, and *Molinia*, clover, sow-thistle, and chicory. When it gets into gardens it shows distinct preference for dahlias, carnations, pinks, nasturtiums, parsley, and thyme. In shrubberies it is very destructive to bark and boughs, especially of coniferous trees.

The proverbial expression, "Mad as a March Hare," has reference to the insane antics of the Jack Hare during the rutting season. He grunts and kicks, bucks like a broncho, and has stand-up boxing-matches with his rivals. In bucking he leaps over his opponent and kicks him vigorously with the hind feet. Though usually harmless, these encounters have been known to have fatal terminations. Though regarded generally as a mute animal, this is not the fact. The Hare has a low but clear cry, which has been described as "don't," "ōnt" or "aunt," with varying inflections denoting different moods. When wounded or badly frightened it utters a scream

like that of a child in pain, and sportsmen have declared that the pitifulness of it caused them to give up shooting Hares. They have also a warning sound made by grinding the teeth, and it is passed on from Hare to Hare, having the same result as the stamping of feet by the Rabbit. The amorous notes of buck and doe are different, and their imitation by poachers and gamekeepers is known as Hare-sucking.

The doe is a model mother for a time, and will fight desperately in defence of her young ; but as soon as they are capable of looking after themselves she casts them off or deserts them.

Alpine Hare (*Lepus timidus*, Linn.).

Alternatively known as the Scottish or Variable Hare, the present species is intermediate in size between the Brown Hare and the Rabbit. The first name has reference to the fact that it is indigenous only in Scotland and the neighbouring isles. It has been introduced into England and Wales, but except in the northern counties and some of the Welsh mountains has not established itself. The name Variable Hare denotes its change of hue at the beginning of winter after the manner of the Stoat. In Cheshire it is known as White Hare. Respecting this winter whitening of the fur, fierce controversies raged for many years ; one school contending that it was due to a complete moulting of the summer fur, as a new growth without colour was produced. The opposition claimed that there was only one moult—in spring—to get rid of the too conspicuous white coat as the snow with which it harmonised melted away. They contended that the old hairs became altered individually by the abstraction of pigment, or by the development of air-bubbles. Evidence which was considered conclusive was brought forward by both sides, and opponents remained unconvinced. In the early days of the twentieth century, however, Metchnikoff

showed that the senile whitening of human hair was due to the activity of certain motile cells, which he termed chromophages or colour-eaters, which remove the pigment granules and consume them. At a later date he showed that the same process caused the whitening of the hairs in the Scottish Hare, and of the feathers of the Ptarmigan—which undergoes a similar change of colour. It is noteworthy that the black tips of the ears, like the black tip of the tail in the Stoat, never change colour.

As already stated, the Alpine Hare is smaller than the Brown Hare, the combined length of head and body being about twenty inches, but the head is proportionately larger, the ears and tail shorter, and the legs longer. The fur is more woolly and of a duskier tint in summer, the whiskers shorter and finer, the eyes rounder, and the hair on the underside of the foot softer. Behind the breast the under parts are white, and the tail wholly so. Another name—Blue Hare—is suggested by its appearance in autumn and spring, when the summer and winter tints are mingled in its fur. The coat becomes closer and longer in winter than it is in summer. Sometimes the winter coat is retained longer than usual, through some unexplained retarding of the spring moult. Black and buff variations have been recorded. The average weight is between five and six pounds.

The habits of the Alpine Hare are very similar to those of the Brown Hare ; but it is less timid, and when alarmed clears off in a more leisurely and less excited manner. As contrasted with the nervous terror of the Brown Hare and Rabbit, the Alpine Hare may be said to be comparatively tame. Instead of making a form it hides in rock crevices and among stones where it may be sheltered from the sight of birds of prey overhead. Occasionally, and especially where there are no rocks, they excavate burrows a few feet in length in the hillside or into the peat-bank. In general its food is similar to that of the Brown Hare ; but it is said to add lichens to its bill of

fare in winter, and to grind up fir-cones in order to obtain the seeds.

Precise observation is still needed respecting the breeding habits of the Alpine Hare, but they do not appear to differ greatly from those of the Brown Hare, two or three litters being produced in the year, and the leverets varying in number up to eight.

Irish Hare (*Lepus hibernicus*, Bell).

The abundance of Hares in Ireland has been noticed in literature for more than a thousand years, but it was not until 1833 that it was suggested that the Irish Hare was anything more than a variation of the Brown Hare. Even so, until quite recently it has been accepted by most of the high authorities as, at best, a variety or sub-species of the Alpine Hare. It occurs naturally all over Ireland, and is not found elsewhere except where distinct attempts have been made to introduce it. Even in places where this introduction has succeeded in establishing colonies—as in the Island of Mull, where it runs with the Alpine Hare—it refuses to breed with other kinds. Barrett-Hamilton is satisfied that it is distinct, and probably a direct descendant of the extinct *Lepus anglicus* whose remains are found in late Pleistocene rocks.

It is a larger beast than the Alpine Hare. The head and body average about twenty-three inches in length, and the tail about three inches. The ears slightly exceed the tail. The average weight is about seven pounds; but exceptionally exceeds nine, and in one case ten pounds has been recorded. It has russet fur, not smoky brown or "blue" as in the Alpine Hare; its winter whitening is not regular as in that species, and is frequently patchy, russet "islands" being left surrounded by white.

As compared with the Brown Hare, the Irish Hare is smaller and of more graceful build, but the head is relatively longer

and broader, the eyes rounder, the ears shorter and the limbs longer.

Though it does not dig burrows of its own, it has been known frequently when coursed to take refuge in a Rabbit-burrow. Though, like the other Hares, solitary, the Irish Hare shows a tendency to gregariousness at times. They have been seen in the North of Ireland moving in droves of two or three hundred, like Deer.

It has several litters during the year, averaging three leverets a litter. They seldom remain long together, either moving apart of their own accord or being separated by the old doe. They are able to run when only an hour or two old.

Red Deer (*Cervus elaphus*, Linn.).

The largest and noblest surviving member of the ancient British fauna, the Red Deer to-day has a very limited range—the mountain glens of Scotland and Westmorland, in the north, and the wide Devon and Somerset moors and the New Forest in Hampshire. Even in the New Forest, where only a few score remain, it is extinct officially, for an Act of Parliament passed in the year 1851 decreed the extermination of the Deer, the reason being that they destroyed a vast quantity of what was then become of far greater national value than venison—the growing timber—and demoralised the inhabitants by creating a race of deer-stealers.

A full-grown Stag, as the male Red Deer is called, stands about four feet in height at the shoulders ; the Hind, or female, somewhat less. The summer coat is reddish-brown, sometimes golden-red, which changes to a brownish-grey in winter by the new growth of grey hairs. On the under parts the colour is white, and a patch of white around the short tail furnishes a "recognition mark," common to most of the Deer family, which serves to guide the herd when they are in flight





Pl. 77.

Young of Brown Hare.

Left in "form" whilst mother feeds

I 125.

before an enemy. A hind bears her first calf when she is about three years old.

All the species of Deer belong to what naturalists know as the even-toed ungulates (animals with divided hoofs). As distinguished from the Horse, for example, which walks on a single hoof in the middle line of the foot, the Deer are supported on two smaller symmetrical hoofs and the axis of the foot passes between them. If you come across the footprints of the Red Deer—"slot" the hunter calls them—in soft ground you will find that fact well-marked. Let me say parenthetically that when observing wild animals, footprints or "spoor" should be eagerly watched for. In the deeper slot of the Deer there may also be slight impressions of two other toes, one on each side behind and above the hoofs.

If you should come across a no longer needed skull of the Deer, take the opportunity for examining its dental arrangements. You are, of course, more likely to meet with it in a museum than in your rambles. You will find the teeth and their disposition do not differ materially from what are found in the jaws of the ox and the sheep ; for like those the Deer is a ruminant, living on vegetable food and having a four-chambered stomach. There are no teeth in the fore part of the upper jaw, the three premolars and three molars of each side being placed well back in the cheek. On each side of the lower jaw we find right in front three incisors or cutting-teeth, which bite against hardened gum in the upper jaw. The Stag alone has a single canine tooth a little behind these, but the Hind is denied this possession. Three premolars and three molars correspond with, and bite against, those of the upper jaw. Dental formula :

$$i \frac{0}{3}, c \frac{0}{1}, p \frac{2}{3}, m \frac{3}{3} = 32.$$

The food of the Deer is herbage and the young shoots of trees and shrubs. It is this fact that led to their nominal extermination in the New Forest and other places. By nature they are woodland animals—although their greater prevalence

to-day in the Highlands might give us a different impression—and in the winter especially do great damage to the plantations of young trees. Agricultural lands in their vicinity also suffer greatly, a whole field of turnips being ruined in a night by a visit from a herd of Deer. They also destroy wheat, potatoes, and cabbages; and in the woods consume many toadstools, acorns, and chestnuts.

In spring and summer whilst his horns are growing the Stag lives apart from his kind, but in the early autumn when these are well-developed and hard, we may in suitable localities hear his “belling” call to the Hinds, or in defiance to some rival.

“The wild buck bells from ferny brake,”

as Sir Walter Scott puts it. There is a good deal of furious fighting when two jealous Stags of similar age and strength meet in the vicinity of the hinds. He is then in the prime of condition, his neck and shoulders clad in a thick mantle of long brown hair, and his head adorned with the noble pair of antlers that reveals his age. Those that decorated and armed him last autumn and winter were shed bodily about March, and a new growth started soon after from the burred frontal knobs that were left. It is important to notice the difference between these solid though temporary growths and the mere shells that permanently decorate the heads of oxen, sheep, and goats. In the Deer they are what biologists term secondary sexual characters; they are possessed by the males only, and cast in their entirety at the end of each breeding season with its frequent contests between the Stags. The history of these antlers is strangely like that of a tall perennial herb whose stems and branches die down to the rootstock each winter—that is, after the plant's breeding season—and start into more vigorous growth each spring. The “rootstock” of the Stag's horns makes its appearance at an early age, and its annual growth is more numerously branched each succeeding year.

The growth of the Stag's horns is said to keep pace with the growth of the bracken among which he rests.

When the male Deer-calf is a few months old he becomes distinct from the female by the appearance of two knobs ("bossets") on the front of the head; he is then a *knobber*. Next year these become longer and pointed ("dags") and he becomes known as a *brocket*. The third year a branch appears forward—the brow antler—and he becomes a *spayad*. The fourth year a second forward antler—the bez-tine or bay—is produced at about a third from the summit of the now long horn; and he is known as a *staggard*. The tray (*très*) or royal antler appears near the summit in the fifth year, and this entitles the young Deer to the title of *Stag*: he has come of age. From the sixth year, when the crown of antlers begins to form at the summit by the production of tines in several directions at the same height, he becomes a *Hart* or *Stag of Ten*; and in former days he could advance beyond that dignity by escaping with his life after being hunted by the King, thereby earning the rank of a *Stag Royal*. If he lives long enough he may wear a pair of antlers each having as many as forty-eight points. He is considered, by the way, to live for forty years.

The antler has a core of solid bone covered by a continuation of the soft skin of the head, which bears a close pile of short hair and is known as the velvet. When the core has attained to its proper solidity and hardness, the growth of the rough burr at its base, pressing on the blood vessels and stopping their further supply to the velvet above, causes the death of the latter; and the Deer by rubbing the new structure against tree trunks and branches, tears off the velvet in strips, and is then able to do battle with his peers. The ensuing period of sexual unrest having been passed through safely, the whole structure down to the burrs is parted with, and a finer set of antlers begun. The whole process of antler growth occupies about ten weeks, and during this period the Stag is always in poor

condition, and seeks solitude. What becomes of the dropped antlers is somewhat of a mystery, as few of them are found, and these usually odd ones.

If one were seeking to judge the habits of the Red Deer from a finely stuffed specimen in, say, the Natural History Museum, standing erect with fully developed antlers, one would feel justified in saying, as many have said—"This is a creature of the open mountain-side and the moorland, where there are no trees whose branches could entangle these branching horns. No adornment could be better fitted for keeping the noble beast out of the woods." Yet the Deer can actually run through dense woods with ease, and we know from its habitats in other countries where it is still plentiful, that it is a true woodland animal. The explanation is evident if, during a Stag hunt, we see the hunted seek refuge in a wood. The Stag throws his head back so that his antlers lie along each side and protect his body from many a bruise that might otherwise be inflicted by the branches as he rushes through the undergrowth. The antlers may be used with deadly effect in self-defence, and many a hound is killed by a Stag at bay. Their function appears to be mainly protective against carnivorous beasts; they are seldom if ever effective against those of their own kind.

The mating of the Red Deer, as we have indicated, takes place in the autumn; and in the spring the Hinds separate, each retiring to a lonely spot among the bracken where her single calf (rarely two) is born about the end of May. The little deer is already covered with fur, and its back and sides are dappled with white after the manner of the Fallow Deer, though unlike the livery of that species the spotting of the Red Deer is not retained beyond calthood. The calf is born with some intelligence also. Mr. St. John tells how, one day in the Highlands, he "was watching a Red Deer hind with my glass, whose proceedings I did not understand, till I saw that she was licking a new-born calf. I walked up to the place, and as soon



Pl. 78.

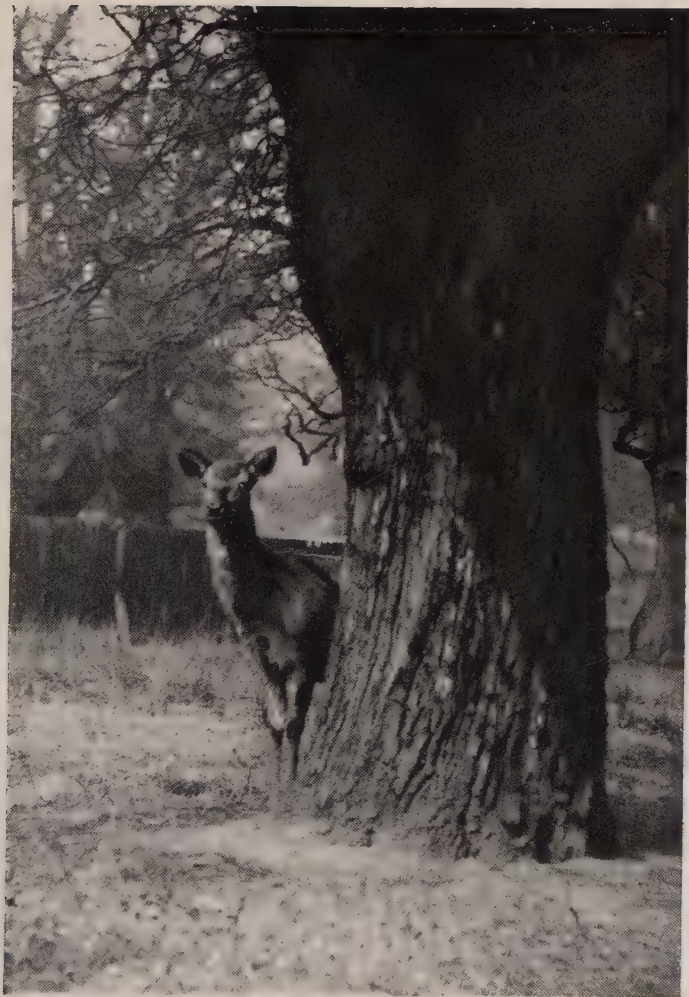
Fallow Deer Buck.
Cervus dama.

/ 128.



Pl. 79.

Alpine Hare.
Lepus timidus.



Pl. 80.

Red Deer Hind.

Female Deer have no indication of antlers.



as the old deer saw me she gave her young one a slight tap with her hoof. The little creature immediately laid itself down ; and when I came up I found it lying with its head flat on the ground, its ears closely laid back, and with all the attempts at concealment that one sees in animals which have passed an apprenticeship to danger of some years, whereas it had evidently not known the world for more than an hour, being unable to run or escape. I lifted up the little creature, being half inclined to carry it home in order to rear it. The mother stood at the distance of two hundred yards, stamping with her foot, exactly as a sheep would have done in a similar situation. I, however, remembering the distance I had to carry it, and fearing that it might get hurt on the way, laid it down again, and went on my way, to the great delight of its mother, who almost immediately trotted up, and examined her progeny all over, appearing, like most other wild animals, to be confident that her young and helpless offspring would be a safeguard to herself against the attacks of her otherwise worst enemy."

It is in the localities described by the author just quoted that we have still the best chance of studying the Red Deer under natural conditions, though there have naturally been some changes since his classic "Wild Sports of the Highlands" was first published in 1845. But the southerner, as we have hinted, has still a prospect of meeting with the noble beast on Exmoor and in Hampshire, to say nothing of the tamer herds in parks. To get a good view of these, they should be approached with a pretence of unconcern : they can often be well observed from a road at a few yards' distance without arousing their suspicions, whereas a few steps towards them on the greensward will cause them to bolt.

Respecting the large numbers of Deer that formerly existed in the south, there is an illuminating reminiscence mentioned by Gilbert White. He says that an old keeper assured him on information from his father, head-keeper of Wolmer Forest,

"that Queen Anne, as she was journeying on the Portsmouth road, did not think the forest of Wolmer beneath her royal regard. For she came out of the great road at Lippock, which is just by, and, reposing herself on a bank smoothed for that purpose, lying about half a mile to the east of Wolmer Pond and still called Queen's Bank, saw with great complacency and satisfaction the whole herd of Red Deer brought by the keepers along the vale before her, consisting then of about five hundred head. A sight this worthy the attention of the greatest sovereign!" Even more striking is the confession of a notorious deer-stealer in the New Forest, who assured the Rev. William Gilpin, author of "Forest Scenery," that in five years he had killed on an average "not fewer than a hundred bucks a year."

It should be stated that the British examples of the Red Deer are considered to constitute a geographical race known as *scoticus*. The European range of the species extends from the Mediterranean to central Sweden and central Norway.

Fallow Deer (*Cervus dama*, Linn.).

The Fallow Deer is recognisable at a glance as distinct from the Red Deer by the entirely different character of the antlers. Those of the Fallow Deer are flattened and expanded in all the branches of the upper part, though the main stem or "beam" is rounded as in the Red Deer. With the exception of the equivalents of the brow-antler and the bez-tine the antler forms a broad curved plate whose margins run out in a number of flat points. It is known as a palmate antler, comparable to the palm of the hand with its finger prolongations. These horns are shed annually, like those of the Red Deer, but slightly later. There are no canine teeth in either sex.

The Fallow Deer is smaller than the Red Deer, the Buck standing only a little more than three feet at the shoulders, and

the Hind somewhat less. It differs in colour, too, from the Red Deer, being a paler red or reddish-yellow above spotted with white, and yellowish-white on the under parts. The tail is longer than that of the Red Deer, and is kept in constant motion from side to side. The vertical white stripe on either side of the rump shows up strongly when the animal is in retreat. In winter the fur darkens; and some of the tame herds in parks show this dark coloration at all seasons. This has been explained by the statement that they are descended from a darker, hardier race introduced from Norway by James I.; but Harting says this variety was in Windsor Park as far back as the year 1465. It is this dark form that is met with in Epping Forest. It may also be seen in Richmond Park, where, however, the lighter form is in the majority.

In this connection it should be mentioned that it is believed the Fallow Deer was introduced to Britain by the Romans, though fossil remains found here show that it was a true native originally. One is inclined to be somewhat suspicious of these introductions attributed to the Romans. It is quite possible that in their desire to enjoy all their continental luxuries they may have brought with them much that was indigenous to the soil. It is possible, too, that they were more proficient as conquerors than as observers of Nature. Cæsar, for example, has left it on record that, when he hewed his way through the dense forests between the south coast and London, there were no beech trees growing, whereas every botanist who has devoted attention to the origin and distribution of our flora is convinced that the invasion of southern England by the beechwoods of the Continent took place ages before great Cæsar was born, and before the separating English Channel was more than a river valley. Men who could overlook so majestic and plentiful a tree as the beech on our chalklands, were capable of not seeing the shy Fallow Deer, which has a wonderful power of vanishing silently among the bracken. However, modern authorities

are of opinion that the Fallow Deer is native only in the Mediterranean region of Europe and Asia Minor ; elsewhere it has been introduced by man.

In addition to the marked difference in the form of the horns in these two species of Deer, there is also a distinction in the development of these ornaments. During its first year the Fallow fawn gives no sign of such a growth, but in its second it produces a pair of short unbranched prongs, which gives the fawn its name of *pricket*. The next year there is a great advance, for each simple prong is succeeded by a horn that bears two forward tines, and the extremity of the beam is slightly expanded and flattened, and its margin indented. In the fourth year the form is similar but more developed, the flat portion of the beam being much larger and its outer margin more regularly toothed or snagged. The fifth year shows further advance along the same lines, and the animal becomes known as a *buck of the first head*. In later years the additions are merely an increase in the number of spillers or snags to the flattened beam.

During the breeding season and throughout the winter Fallow Deer may be encountered in mixed herds of both sexes ; at other times in parties of Bucks *or* Does. Like the Red Deer it is a great enemy to the forester, and in winter time is not content with browsing on the young shoots of the trees, but utterly kills many by destroying their bark. They also eat acorns, chestnuts and horse-chestnuts. By reason of their feeding more in the lowland woods, where the diet is more liberal, the venison of the Fallow Deer is considered more tender and of finer flavour.

The Fallow fawns are born in May or June in a close retreat far in among the bracken. Though mostly there is only one at a birth, there are frequently two, and rarely three. The fawn is capable of taking care of itself when only a few hours old. As illustrating this point, we may quote an incident



Pl. 82

K 132.

Fallow Deer Hind.

The hind is smaller than the Buck, and of more slender build.



Pl. 83.

Roe Deer Fawn.

K 153.

Watching for its mother from its birth-place.

narrated by Mr. John Watson, who has written intimately of the wild life of Westmorland. He says: "Once we came suddenly upon a pretty little soft-eyed creature, evidently only a few hours old. It squatted closely as we stood over it, but when aware that it was observed, feigned death in the most amusing manner, only with the softest and most wide-open eyes imaginable. As we stooped towards it, with half a dozen bounds it cleared the brake, and as a rapid stream stopped its further progress, jumped in, and, after swimming about twenty yards, came quickly ashore. It then trotted back to its bed among the fern; and yet it is probable that this fawn had not previously used its legs, and had certainly never seen water."

The name Fallow is the Anglo-Saxon *fealewe*, and indicates the gilvous colour of the lighter race. Gray in 1843 separated the species from the Linnean genus *Cervus* under its species name of *Dama*. The modern effort to get back to original species names under the rules of priority has caused this Deer to be dubbed *Dama dama* in the newest catalogues. We have preferred to retain the Linnean *Cervus dama*, but our readers can say *Dama dama* if they like it better.

Roe Deer (*Capreolus caprea*, Gray).

A third species of Deer, the Roe, is now to be found only in our northern mountain woods. It is the smallest and prettiest of our native species, and appears to have been formerly the most widely distributed of the three (though never an Irish species), but to have been driven further and further north by the advance of population and cultivation in the south. Even so, quiet ramblers in the thicker woods and plantations of the New Forest have a slender prospect of seeing it. About the beginning of the nineteenth century, Lord Portarlington introduced Roe to the woods of Milton Abbas, in Dorset, where they prospered and increased. In the year 1876, or thereabouts,

it is said that some of these made their way across country for twenty-five miles and settled in the New Forest. There are very few of them, and this fact combined with their cleverly elusive movements in the dense coverts they affect, makes the chance of seeing them very remote, more particularly as the Roe is nocturnal in its habits.

The Roe stands only about two and a quarter feet at the shoulders. Its colour in summer is bright red-brown, the coat short and smooth; but in winter it becomes long and brittle, and the colour changes to a warm grey. The tail is so short as to be scarcely visible among the surrounding hairs which, as well as the under parts and the inner sides of the thighs, are white. The ears are relatively larger than those of the other species, covered with long hairs and whitish inside. It has a white chin and a white spot on each side of the dark muzzle. A mature buck weighs from forty to fifty pounds. There are no signs of horns in first year fawns; in the second year they make their appearance as simple unbranched prongs. The third year the horns are forked, a short tine pointing forwards; those of the fourth year have an additional tine directed backwards, and this marks the full complication of their structure. In later years they have the same general design, but, of course, are each year larger; at their maximum they are only eight or nine inches long, and are nearly upright. Small and primitive though these horns are, they are very effective weapons, and there have been occasions when they were used with fatal effect against human victims. They have no canine teeth.

Roe Deer never congregate in large herds, but form small family groups. In spring the hind retires deep into the covert, where her two (sometimes three) spotted fawns are born; and when they are about a fortnight old, she brings them out into the more open parts. Charles St. John, who, in the first half of the nineteenth century, had full opportunity for a close study of the natural history of the Highlands, has much to say of Roe

P. 84.



A 134.

Common Lizard.

Not necessarily a family party.



10.85.

Common Lizard female.
Lacerta vivipara.

A 135.

Deer and their habits. He remarks that, "The greatest drawback to preserving Roe to any great extent is, that they are so shy and nocturnal in their habits that they seldom show themselves in the daytime. I sometimes see a Roe passing like a shadow through the trees, or standing gazing at me from a distance in some sequestered glade ; but, generally speaking, they are no ornament about a place, their presence being only known by the mischief they do to the young plantations and to the crops. A keeper in Kincardineshire this year told me that he had often, early in the morning, counted above twenty Roe in a single turnip-field. As for the sport afforded by shooting them, I never killed one without regretting it, and wishing that I could bring the poor animal to life again. I do not think that Roe are sufficiently appreciated as venison, yet they are excellent eating when killed in proper season, between October and February, and of proper age. In summer the meat is not worth cooking, being dry and sometimes rank."

The Roe is a good swimmer, and often crosses rivers, probably in order to get a change of food, though sometimes there is no reason apparent. On this point St. John tells us : " For some unknown reason, as they do it without apparent cause, such as being hard-hunted or driven by want of food, the Roe sometimes take it into their heads to swim across wide pieces of water, and even arms of the sea. I have known Roe caught by boatmen in the Cromarty Firth, swimming strongly across the entrance of the bay, and making good way against the current of the tide, which runs there with great rapidity. Higher up the same firth, too, Roe have been caught when in the act of crossing. When driven by hounds I have seen one cross Loch Ness."

The dentition is the same as that of the Fallow Deer.

Common Lizard (*Lacerta vivipara*, Wagl.).

There are still two small groups of back-boned animals to be described, representing the classes Reptilia and Batrachia. To the average man they are all Reptiles, and he has this justification for so regarding them—that until recently they were so classified by the great naturalists. Modern biologists, however, dealing with structure and organisation rather than with external form, find that this association of the scale-clad Lizards and Serpents with the soft-skinned Frogs, Toads, and Newts cannot be defended, and they have separated them into the two classes named. The reasons for this separation will become manifest in our descriptions of the several species, so that a preliminary dissertation on the subject is not necessary.

Sitting on a sunny, heather-clad hillside it will not be long, probably, before we see the active little Common Lizard peeping at us from under cover or leaping swiftly over the crowded plants. Its movements are so rapid that it is not at all easy to follow them in detail, or even to catch one for closer examination. It can run nimbly enough with a gliding motion, for the body and tail are scarcely lifted from the ground; but the principal mode of progression is to shoot forward horizontally from one tuft of herbage to the next. They run with as much facility over the shoots of heather or heath, and their long, delicate fingers and toes secure them as sure a landing as that of the Squirrel leaping from branch to branch. When we have hit upon a spot where we have seen several Lizards thus active, a good plan is to sit down quietly for a time, and keep our eyes on a patch of sand that is fully exposed to sunshine. In a little while a Lizard, maybe two or three Lizards, will appear from under the heather or other plants and bask in the sun.

So seen, we note that they are about five inches in length, which is only an average size. The maximum attained by males is six inches, and by females seven inches. The females

are not merely longer, they are altogether of larger proportions ; but the male is the more graceful of the two, his tail tapering gradually from the slender body to the very fine tip. Though the tail is in both sexes equal in length to the head and body, that of the female appears shorter owing to its sudden tapering beyond the thick basal portion.

The colour is some tint of brown, varying considerably in different individuals from yellow-grey to purple-brown, as a ground tint, upon which is laid variable dark spots forming more or less broken longitudinal lines. There is sometimes a



Skeleton of Lizard.

blackish line or band following the course of the backbone to a little behind the hips, and a dark band along the sides edged with yellow. On the underside the males are orange or red, spotted with black ; the females, orange, yellow, or pale greenish, with or without black spots, or a few small grey dots. They appear to moult, or “slough,” in patches, though entire sloughs are found occasionally.

The limbs of the Lizards agree structurally with those of the Mammals, each ending in a well-formed hand or foot with five long and slender digits, each with a curved claw—those of the hand worn short and blunt by their use in scraping the earth.

Their principal food is furnished by the various tribes of insects—flies, beetles, moths, and caterpillars, though spiders

are greatly appreciated. Unless they are very small, caterpillars do not appear to be swallowed, but rather chewed and the skin rejected. The name *vivipara* refers to the fact that the female retains her eggs until they are fully developed and ready to hatch, so that the young are born free from the egg-membrane, or the egg breaks in the act of oviposition or immediately after. They are deposited anywhere: there is neither nest nor concealment, and the mother exhibits no interest or concern in her progeny. These number from six to twelve, and are nearly black. They remain motionless where they were born for several days. They are about an inch long. They start life so well nourished that they take no food for several days, then start hunting for small insects, such as Aphides and other soft-bodied species. The teeth are very small and conical, and unfitted to deal with hard substances; and as the two halves of the lower jaw are firmly connected there can be no distension of the small mouth to accommodate large parcels of food, as happens with the Snakes.

Points to be noted in the external appearance of the Common Lizard, when we have succeeded in capturing one, are the fact that the entire body is clothed with smooth, slightly keeled, and scarcely overlapping scales, small on the upper side, excepting the head, where they are large. On the underside, too, they are larger, especially from the breast to the vent, where they become broad plates, of which there are six rows, the two central rows being much smaller than the lateral ones. A row of larger scales forms a sort of collar across the underside of the neck. The Lizards have not that fixed, ever-open-eyed stare of the Snakes. The Lizard can follow your movements with his eye, and wink at you intelligently, because he is provided with eyelids, which the Snake lacks. He closes his eyes in sleep. When he puts out his tongue to ascertain whether an insect is good for food, you will notice that the broad tip of it is notched into two rounded lobes, instead of being forked into two thread-like



Pl. 86.

Sand Lizard female.
Lacerta agilis.

K 138.



Pl. 87.

Common Lizard.

K 139.

Upper and under sides, showing different scaling.

points, as in the snakes. The usual attitude of the Common Lizard is with the extended tail and greater part of the body resting on the ground, or other support, whilst the head and fore parts are raised on the arms, and the muzzle turned to one side in an attitude that suggests listening. It has been stated that Lizards are susceptible to musical sounds, and that they may be attracted from their hiding-places by judicious whistling.

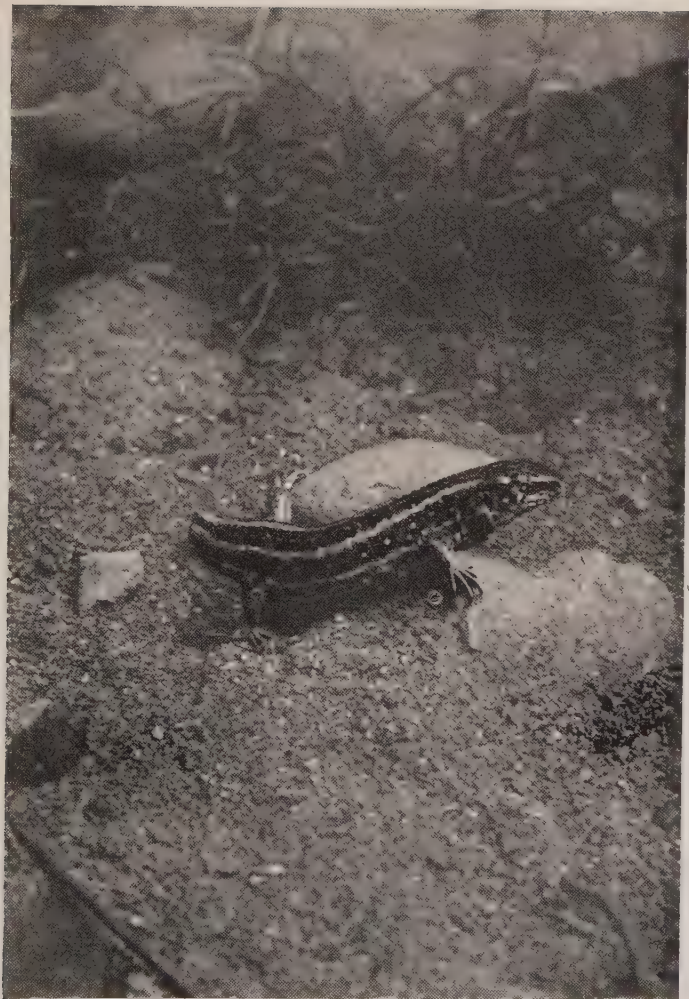
On the underside of the thighs will be found a row of small, roundish scales, all perforated, and numbering from seven to thirteen. The perforations are filled with a yellowish or brown substance, which appears as a little cone above the opening. Its purpose has not been settled satisfactorily, but Cope suggests that it may be for giving the Lizard a better hold on slippery surfaces, seeing that the weight of the body rests chiefly upon the thighs. Another point that should be mentioned is the brittleness of the tail. In catching—or attempting to catch—a Lizard, he should be grasped by the shoulders. If the tail be held instead, it will probably come away in the hand, snapping at the base as readily as though it were glass or sealing wax. A sort of tail will grow from the stump if the Lizard lives long enough, but it is always a poor, ungraceful affair.

This species is the Furze Evvet of the New Forest, and the Harriman of Shropshire. In Cheshire it is the Swift. In suitable situations—sandhills, fallows, heaths, and moors—it may be found all over Great Britain, including the Isle of Man, and in most localities it is common. It is the one true reptile that Ireland possesses, and it appears to occur in all parts of the island, though not in any abundance. It appears (like the Natterjack) to have escaped the attentions of St. Patrick when “He gave the snakes and toads a twist and banished them for ever.” Its wider distribution includes Northern and Central Europe and Siberia, where it shows a preference for mountainous and high-lying country.

Sand Lizard (*Lacerta agilis*, Linn.).

At a glance there is little beyond its superior size to distinguish the Sand Lizard from the Common Lizard ; and in consequence the earlier records of its occurrence in certain localities have had to be severely revised. It appears to have been the rule of many recorders, when specimens of the common species that exceeded average proportions were captured, to put them down as Sand Lizards without any critical examination. The truth is that as a British species the Sand Lizard is found only in certain restricted localities in the southern counties of Dorset, Hampshire, and Surrey, and the sandhills by the sea in Lancashire and Cheshire. Its southern habitats agree almost exactly with those of the Smooth Snake, for which it provides a favourite food. It is not found either in Scotland or Ireland.

The adult male of the Sand Lizard is about seven and a half inches long, of which more than half is tail. The female is about half an inch longer, but the additional measure is added to the body, for the tail is less than half of the whole length. The general colouring may be described as a sandy-brown, with broken bands of darker tint. There is, of course, a considerable amount of colour variation, and in the males there is a marked tendency to a green suffusion, which in many cases is so pronounced as to lead to a belief that the examples in question are the non-indigenous Green Lizard (*Lacerta viridis*). It was, no doubt, some markedly green males of the Sand Lizard which Gilbert White saw "on a sunny sandbank, near Farnham, in Surrey," and thought were true Green Lizards. There are rows of dark and white spots along the sides of the back, flank, and tail, which give the appearance of longitudinal stripes. The green of the male is more pronounced during the breeding season (May-June) when it is also evident in the usual black dotted yellow of the underside. The black spots

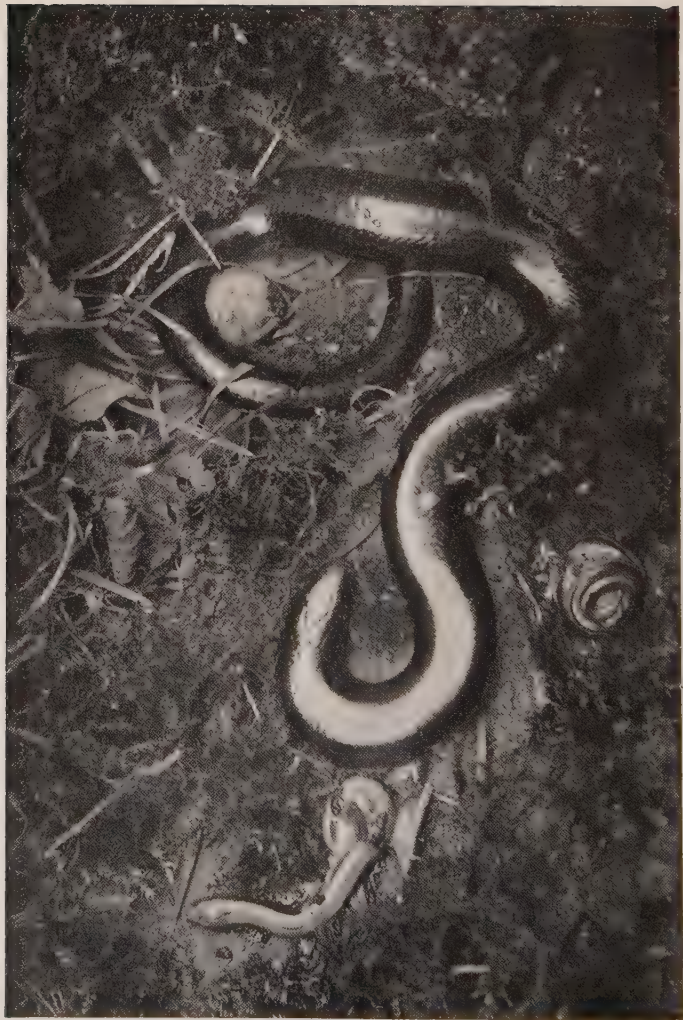


Pl. 88.

N 140.

Sand Lizard.

The tail, seized by an aggressor, has been parted with.



along his sides have white centres. The under parts of the female are cream-coloured, and the three rows of white-centred spots on the sides are dark brown.

The female deposits from five to twelve—usually about eight—eggs which have white shells of the consistency of parchment. These are covered with sand or leaves, and left for the sun to incubate. They are laid in July, and the young are hatched in the same month or early in August. The young Sand Lizards are grey-brown above and whitish below.

Like the Common Lizard, the Sand Lizard is very apt to lose its tail by voluntary amputation; and short-tailed specimens are sometimes found which are to be explained by supposing that the original tail has been shed and another grown.

Characters that distinguish the Sand Lizard from the common species will also be found in the general covering of scales—which are strongly keeled—and in the ten to eighteen on the thigh that are perforated, which are triangular, larger and flatter than the corresponding scales in the Common Lizard. If we have an opportunity for examining the mouth, too, we shall find that in addition to the teeth on the jaws there is a row of them—vomerine teeth—on the hinder part of the palate. These are not present in the Common Lizard. Both species spend the winter in a dormant state underground.

Outside England, the Sand Lizard is a native of Central and Northern Europe, its range extending to the North of Russia and Siberia; but it is a lizard of the lower lands, whilst the Common Lizard on the Continent is more plentiful in mountain districts.

There are two species of Lizards that are natives of the Channel Islands, and strangely one and not the other of these is usually included in lists of British animals because the islands are politically British. But the fauna and flora of the Channel Islands belong to those of the nearest mainland

—France—and therefore should not be included among British species unless they occur also in England, Wales, Scotland, or Ireland. The two species referred to are the Green Lizard (*Lacerta viridis*), with tail equal to three-fourths of its entire length, and the Wall Lizard (*Lacerta muralis*) of variable brown coloration and a tail one and a half times the length of the head and body. The Green Lizard may sometimes be seen in this country as an escape from captivity, being a favourite subject with the keepers of vivaria.

Slow-worm (*Anguis fragilis*, Linn.).

The average person cannot understand why the naturalist should be so “pig-headed” as to regard the Slow-worm, Blind-worm or Deaf-adder as a lizard when it is so obviously a snake, and has no legs such as a properly constructed lizard should have. If the naturalist were given to argument of the *tu quoque* order he might retort by asking why the average man persists in styling a swift-gliding reptile a Slow-worm, or one with brilliant eyes a Blind-worm? But the probability is that he will quote Longfellow and tell the inquirer that “things are not [always] what they seem”—that under the close and polished, uniform scaly covering there are vestiges of limbs that have been discarded in the long evolutionary history of the species; that it has eyelids like other lizards, that the two sides of the lower jaw have a bony union in front, and that it has a notched not forked tongue—characters that do not agree with the structure of any snake. But all this will fall upon deaf ears, and the average man will go on slaughtering Slow-worms at sight, and believing that he has done a brave and meritorious thing.

The Slow-worm attains a maximum length of seventeen or eighteen inches, but the average “large” example is about a foot long. Its head is quite small and short, not so broad as

the body just behind it. The tail, which is much longer than the head and body, and longer in the male than in the female, tapers gradually, and is very slender before ending in the short sharp point at the tip. In many examples this graceful tapering of the tail is not evident, because at some time it has been broken short, and the effort to renew it, whilst it gives a sort of finish, never appears to be a success. There is usually a ragged end to the old part, and the narrower new part appears to have been rather clumsily stuck inside the fringe of old scales. Many specimens are in this condition, for the Slow-worm is much more ready to part with its tail than either of our other lizards. The scales on the upper and undersides are nearly uniform in size and shape, broader than in the other lizards and rounded on the hind margin which is thinner than the dark-coloured central part of the scale. The scales are quite without keels, polished and plainly overlap their fellows. There is a thin dark line down the centre of the back, and another on the upper part of each side.

The small mouth has the jaws well armed with uniform slightly curved teeth, whose points are all directed backwards. The bright eyes are placed low down, not much above the upper jaw. The head is covered by much larger scales than usual, but in this case the head regions are not so clearly mapped out as in the other species, owing to the thin edges of the scales giving no strong outlines. With a live Slow-worm in the hand one gets a clear idea of the smoothness and close attachment of the scaly covering. The feeling conveyed is that there are no scales: that the external coat is continuous and homogeneous; and one marvels at the reptile's power of gliding rapidly through the fingers. Though the Slow-worm may be found on the edge of the wood, or on the heath, sunning itself early in the spring, and apparently a lifeless casting in bronze, on the slightest alarm it dives into the vegetable soil and speedily disappears. In its basking attitude Slow-worm

may be an appropriate name ; but when it begins to move we are astounded that it has been able to keep so ridiculous a name.

The food of the Slow-worm is governed by the small size of the mouth. It is not an easy matter to study its feeding habits when it is at large, and our knowledge of its food preferences have been derived mainly from Slow-worms in captivity. It will take spiders, small earthworms, and small insects ; but always shows a marked preference for the small greyish-white slug (*Limax agrestis*) that is so great a pest to the grower of tender vegetables. This slug the Slow-worm consumes in quantity. Dr. Gerald Leighton, in his book on the "British Lizards," says : "I can vouch for a meal that consisted of seventeen slugs, the Slow-worm being a large male sixteen inches long. But the usual number taken seems to be from four to ten." Its principal feeding time is soon after sunset, when the slugs are most in evidence on the surface and beginning to make their nefarious attacks on the food of man. If the gardener, professional and amateur, could only be taught such facts, the sudden descent of the sharp edge of spade or hoe upon one of his ablest helpers might be stayed. The reptiles and the batrachians are all his friends.

Like the Common Lizard, the female Slow-worm retains her eggs until they are fully developed, so that in August or September she produces a litter of six to twelve animated silver needles about two inches in length, with a thin black line along the centre of the back, and black on the underside. These are very active and very beautiful, perfectly independent and able to fend for themselves, catching insects, but at once showing preference for slugs if these are to be found of a size small enough to pass the tiny mouth. There is a record of a batch that were three inches in length at birth, but this is unusual. Occasionally the eggs are deposited before hatching.

Although in early spring the Slow-worm may be seen along

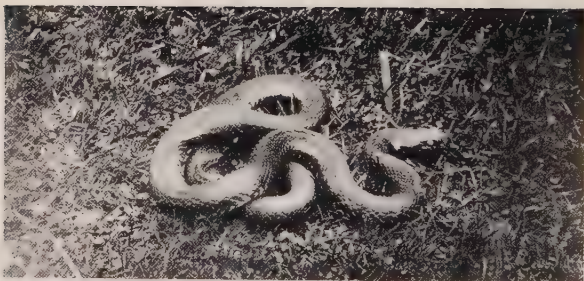
Pl. 90.



SLOW-WORM.

Amphisbaena

N 144.



Pl. 91.

Grass Snake casts its skin.

1. Immediately before sloughing. 2. Operation nearly complete.
3. In new attire.



Head of grass snake.



Pl. 92.

Viper.

Difference of form and scaling in heads of the two species.



hedgerows frequently in the daytime, later in the year it must be sought in the dusk when it is food-finding. It then spends the day under flat stones and in burrows. In Cornwall years ago we could always find a number of Slow-worms by turning over such loose stones along the top of the cliffs; and we have since found them pretty generally distributed without much regard to the nature of the soil. Its principal enemies—besides man—are the Viper and the Hedgehog. In the winter the Slow-worm retires—often in the company of half a dozen or so of its own kind—into an underground burrow or a hollow beneath a large stone, and goes to sleep; but it is the first of the reptiles to reappear at the very beginning of spring. Like its congeners it casts its skin from time to time—apparently about four times a year, but the frequency of the sloughing depends, of course, upon whether it is a good slug year or the reverse, for the shedding of the cuticle is in response to the demand for more room for the growing body. The Slow-worm's length of life is not known; but it does not appear to attain to sexual maturity until it is four or five years of age. We have reliable knowledge of one that was captured when about a foot in length (probably five or six years old), fifteen years ago, which is still healthy and active.

It was in the Slow-worm that the discovery was made in 1886 of vestiges of a degenerate median eye connected with the pineal gland—a discovery that set all the biological investigators of the world at work. The same gland has in the last few years been found to have important influence in controlling the growth of the body in all vertebrates.

The Slow-worm is generally distributed throughout the British Islands, with the exception of Ireland; it is much more plentiful in the south and south-west of England than in the east or north, but even in the south it is much more abundant in some districts than in others. Its wider range includes all but the extreme north of Europe, Western Asia, and Algeria.

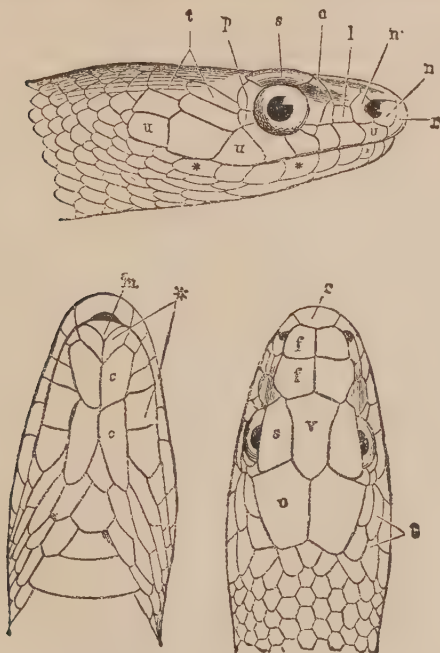
Grass Snake (*Tropidonotus natrix*, Linn.).

Before entering upon a description of the greatly feared though harmless Grass, Ringed, or Common Snake, it would be well to say a few words on the structure of Snakes in general, and so avoid some amount of repetition, for in a general way our three species are alike.

The Slow-worm, our legless Lizard, affords a convenient transition to the Snakes; but the bony skeletons of Snake and Slow-worm exhibit considerable differences. No Snake possesses a breast-bone, blade-bone, or collar-bone, so that all the ribs are free at their ends, and they are strongly curved to produce the cylindrical form of body. When bulky food is taken the ribs can be flattened out to allow of the necessary distension of the body until digestion and muscular pressure have reduced the bulk. The bones of the skull are connected so loosely that the head can be flattened and widened, so that the mouth can admit prey equal to three times the size of the Snake's head under normal conditions. To assist in the swallowing of such large bodies, the two halves of the lower jaw have no bony connection but are united instead by elastic ligaments, so that each half can be moved independently of the other, and by the alternate movement of the two sides with the teeth all pointing backwards the food is worked back to the throat. There are other teeth on the roof of the mouth which make it difficult for living prey to struggle forward and escape when once it has been seized. The teeth are all thinly coated with enamel, and are not planted in sockets. If they should get broken by the severe work imposed upon them, they are soon replaced by others which lie in reserve. Poison fangs are much larger than ordinary teeth, and the enamel is folded so as to produce a groove down which poison is pressed from a gland into the wound made by the point of the fang. The fang is hinged at its base and ordinarily lies pressed back upon the

upper jaw, and is only "erected" when the Snake is prepared to strike.

Externally the Snake is covered by small overlapping scales



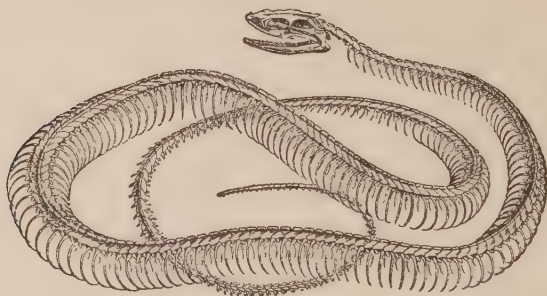
The Head Shields of a Snake.

r, rostral shield; *f*, anterior and posterior frontal; *v*, interparietal; *s*, supraocular; *o*, parietal; *nn'*, nasal; *l*, loreal; *a*, preocular; *p*, postocular; *uu*, upper labial; *tt'*, temporal; *m*, mental; ****, lower labial; *cc*, chin-shields.—After Günther.

on the upper parts and by broad plates on the under surface. The head is covered mainly by shields, each of which has a

definite name, but for the purposes of this book it is not necessary to enter upon a tedious recital of these terms, beyond giving them for reference under the diagram of a Snake's head.

The eyes of a Snake are always wide open, for there are no movable eyelids to close them. The eyeball has slight power of movement under its transparent cover, which protects it much as the watch-glass protects the delicate hands of the watch. As in the Slow-worm, there is no external indication of ears, though these are present under the scales. The very long

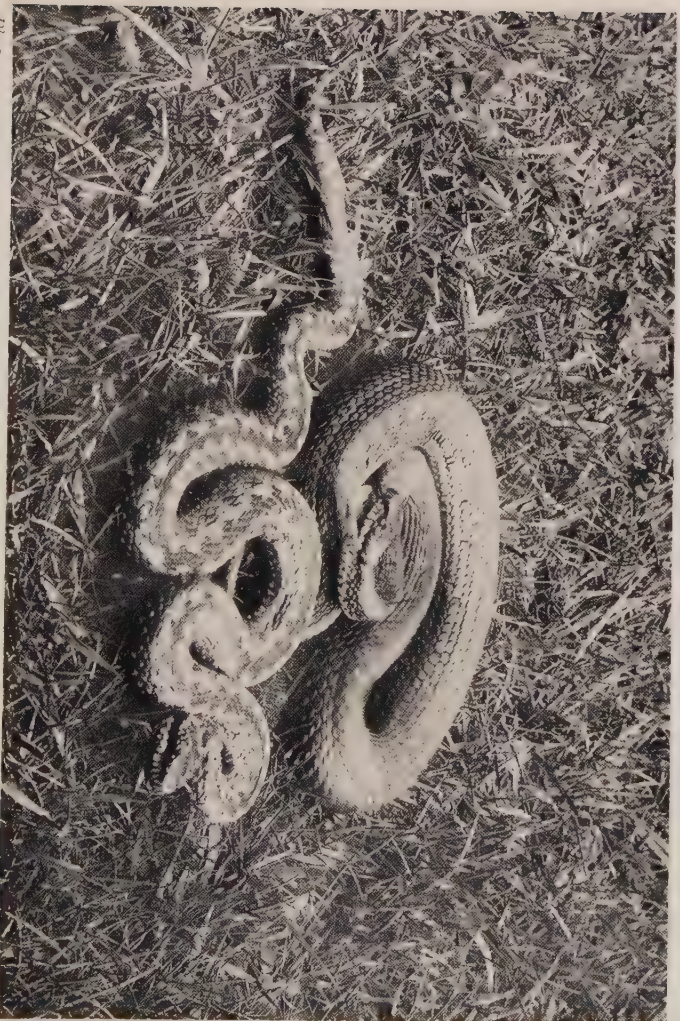


Skeleton of Snake.

and slender tongue divides forwards into two branches, and when not in use is drawn into a sheath at its base. It is constantly used to ascertain the nature of things by contact, and for this purpose is protruded through a little gap in the front of the upper jaw. The gape of the mouth extends far beyond the eye. The forward extremity (*glottis*) of the wind-pipe can be thrust outside the mouth when, owing to the passage of a bulky victim, there is danger of obstruction by compression.

The British Snakes represent the two families Colubridæ and Viperidæ.

Every summer and autumn our daily newspapers afford



Pl. 94.

Vipers.

The two sexes: the lower figure is the male.

L 148.



evidence that on the subject of Snakes the average man has not advanced in knowledge beyond that of his prototype a thousand years or so back. With all that has been done in various ways during the last half-century to spread knowledge of natural things, it is astonishing that editors should admit scare reports about Snakes without a line to set the reader right. Internal evidence shows that nine-tenths of these alarming reports about poisonous and aggressive Snakes refer to the innocuous Grass Snake. This is the kind of thing that reflects the vaunted intelligence and calmness of the average Briton :—

“An enormous snake was killed yesterday at ——, only a few yards from where some children were playing. The Rev. Mr. Blank courageously seized the reptile behind the head, but when it hissed savagely at him he was forced to throw it down. Its head was then smashed with a pole, and finally it was despatched with the aid of a spade. The venomous monster was found to be over three feet in length. Its nest was found and a large number of eggs destroyed.”

A very elementary knowledge of our native snakes—such as all country folk might be expected to possess—would dispose of all this fear and sensation, for no one has ever found a Viper or Adder—our only venomous snake—that measured quite as much as three feet, or that had a nest of eggs.

The Grass Snake is our largest British species, full-grown females averaging four feet in length ; the males a foot less. Exceptional examples are little short of six feet, and in Italy the same species attains to a length of eight feet. It is of graceful form, the body tapering gently from its middle to the very slender tip of the tail. The long, narrow head, covered with large shields, ends in a blunt snout, with eyes and nostrils at the sides. The rather large eyes have round pupils circled with gold and a dark brown iris. Just behind the head there are two patches of yellow or orange (sometimes white) forming

a bright collar which serves to indicate this species at a glance. In large females this collar is sometimes missing. Immediately behind it are two patches of black, often united in the middle line, and behind these the ground colour of grey, olive, or brown is uniform to the tip of the tail. Upon the ground colour of the back are laid two rows of small blackish spots, and a row of short vertical bars along each side. The underside, which is covered with broad plates, is chequered in black and white (or grey); but is sometimes entirely black. The tail accounts for about one-fifth only of the total length.

Apart from the head-shields and the broad plates of the underside, the Grass Snake is covered with nineteen rows of small, overlapping, lance-shaped scales with a central ridge or "keel." These scales are an outgrowth from the skin, and when the Snake moults they do not fall off as the hairs of furred animals do, but the entire skin with its scales is cast intact. It separates first at the edges of the jaws, and the Snake pushes against the ground, stones, or plant stems until the loose skin is behind the head. Then it glides out of the remainder, reversing it in the process. In these discarded sloughs the lens-like covering of the eye will be found unbroken.

In the autumn the Grass Snake retires to some safe shelter under the roots of trees, among the stubs of a coppice, under a brushwood pile or fernstack, in order to pass the winter in sleep. As a rule, several or many associate in hibernation, and when found they are usually twined together in intricate knots. Here they remain until March or April, when the Frogs, Toads, and Newts, emerging from a similar retirement, are available for a good meal. About this time the males seize the females in their jaws, and with their bodies entwined pairing takes place. Some time between June and August the female seeks some convenient mass of fermenting vegetable matter amidst which to burrow and deposit her eggs. If a heap of fresh stable manure is available she will prefer it, the heat hastening

incubation. The eggs—which may number a dozen or anything up to four dozen—are equal-ended ovals with a tough, parchment-like shell, and all connected in a string. As soon as laid they begin to absorb moisture from their surroundings, and increase in size until they are about an inch and a quarter in length. They hatch in from six to ten weeks, according to temperature, and the baby Grass Snakes measure from six to eight inches. Before hatching they are provided with a special egg-tooth projecting from the front of the jaws, which enables them to pierce the egg-shell. It soon becomes loose and drops off after its special function has been performed. The young Snake sheds its skin before taking its first meal, and thereafter goes through the same process four or five times in a year.

The Grass Snake appears to have a life comparatively long. The female is about four years old, with a length of two feet, before she begins to breed. Gadow mentions a fine female which he had alive for nine years, and during this period her length increased from thirty-five to forty-two inches.

Although the Grass Snake may be found frequently about ponds and ditches where there are Frogs, Toads, and Newts to be caught, it is by no means restricted to such resorts, but may be met with on chalk hills, sandy heaths, and other places far removed from water. In addition to the amphibians mentioned, it feeds occasionally on fish, mice, and small birds. The young Snake takes worms, tadpoles, and the young of newts, frogs, and toads. It swims well and often enters the water to obtain its prey. Although an agile reptile, it may be caught without difficulty where the ground is not too rich in mouse runs or too well covered with furze. The undulations by which it progresses are always horizontal, not vertical as sometimes represented by imaginative artists. When captured it seldom makes any attempt at biting, though it will hiss freely and snap its jaws. It usually seeks rather to disgust its captor by the voiding of a fetid secretion with a strong odour of garlic

among other objectionable scents. It soon becomes gentle and tame.

The Grass Snake is widely distributed over England, Wales, and the south-eastern parts of Scotland. It appears never to have reached Ireland. Various attempts have been made to introduce it in the latter country, but the prejudices of the people and their respect for the legendary miracle of their patron saint have always prevented the Snakes from establishing themselves.

Smooth Snake (*Coronella austriaca*, Lacepede).

Although in general appearance similar to the Grass Snake, the Smooth Snake in the hand exhibits a sufficient number of differences to make its identification easy. The smoothness which gives it a name is at once evident to our sense of touch, and is due to the fact that all its scales lack the little keels or ridges that give a certain roughness to the common species. It never attains to so large a size as the Grass Snake, its maximum length being two feet.

The ground colour of this snake on the upper side is grey, brown, or reddish, with small black, brown, or red spots, which are usually in pairs ; occasionally there are three lighter longitudinal stripes. The upper part of the head is sometimes blackish ; this is more frequently so in young examples. A dark streak runs from the nostrils and through the eye to the angle of the mouth. This streak may be prolonged, even to the tail. On the underside the colouring is some tint of orange, red, brown, grey, or black, with or without black spots or dots. The eye has a round pupil like that of the Grass Snake, and this helps to give it a similar gentle appearance.

Prior to the year 1853 British specimens had been regarded as mere variations of the Grass Snake, but in that year it was captured by Mr. F. Bond at Ringwood by the New Forest, though it was not recorded under its proper name until six

years later. It has been found since in other parts of Hampshire, in Dorset, Surrey, and Berkshire; in some places abundantly, especially those in which the Sand Lizard occurs, this being the Smooth Snake's favourite prey. Its usual resorts are heaths, stony wastes and wooded hillsides. Its food consists mainly of Lizards, but it also takes young Snakes and Slow-worms; occasionally it consumes mice and mice-like mammals including the Voles and Shrews. When these are sufficiently large it is said to coil around them in Boa-constrictor fashion.

Pairing takes place soon after emergence from hibernation in spring. As in the case of the Slow-worm and the Common Lizard, the eggs are retained until the young are ready to hatch out, and they are born about the end of August. They vary in number from two to fifteen, but usually there are about six to a birth. They are enveloped in a thin membrane which is ruptured immediately, and the Snakes are seen to be about five or six inches in length.

Like the Grass Snake this species emits an objectionable odour when captured, and at first attempts to bite, but this unfriendly phase passes quickly, and it becomes perfectly tame and exhibits a considerable amount of intelligence.

It may be as well to add that, if we count the rows of small scales on the back and sides of either of our non-venomous Snakes, we shall find there are nineteen of them. In the Viper there are twenty-one rows—rarely nineteen or twenty-three. Each one of these scales is marked with a tiny pit which appears to coincide with the end of a nerve fibre, so that one may say the sense of touch resides in every separate scale. The head is less distinct from the body than is the case in the Grass Snake; and the slender tail is one-fourth of the entire length in the male and one-sixth in the female.

The Smooth Snake is found throughout the greater part of Europe.

Viper or Adder (*Vipera berus*, Linn.).

At a superficial glance the Viper is quite distinct from our other Snakes. Instead of the long, gracefully tapered body of these, the Viper is short and thick in the body with a short tail. So far as the length is concerned, the average Viper is less than two feet. A few exceptionally large females have been recorded measuring two feet eleven inches ; but the female is always slightly longer than the male—usually about an inch more. Two feet three inches may be regarded as the ordinary maximum for a female. The head is flatter above, and it broadens behind the eyes, so that it is very distinct from the body ; further, the shields on the head are very much smaller than the corresponding plates of the Grass Snake. The iris of the eye is coppery-red, and the pupil is vertical—which usually denotes nocturnal habits, but the Viper is active by day as well as by night, and is fond of basking in the sunshine.

Respecting colour, there is a considerable range of variation, much of it sexual ; but, generally speaking, it may be said to be some tint of brown, olive, or grey, and this ground colour may be so dark that the darker markings are scarcely perceptible on a cursory view. Along the sides there are whitish spots, sometimes reduced to mere dots. The brown, red-brown, or olive males have black markings ; the grey or whitish males are marked with brown or black, and have the underside black. The throat is black, or whitish with scales spotted or edged with black.

The females if brown or brick-red have dark brown or red markings ; olive females have brick-red bands or spots. The yellowish-white chin and throat are sometimes tinged with red. The eyes of the female are smaller than those of the male.

The markings are subject to a good deal of variation as well as the ground colour. The usual wavy or zigzag line down the centre of the back, with a series of spots on either side, may be

broken up into oval spots ; and the characteristic pair of dark bars on the head may form either a Λ or an \times . The broad shields which cover the lower surface may be grey, brown, bluish, or black, or bluish with triangular spots of black, sometimes with white dots along the margins. Below the end of the tail the colour is yellow or orange. Specimens have been recorded almost entirely of a rich black, the excepted portion being the whitish underside of the head and throat.

The usual haunts of the Viper are sandy heaths, dry moors, the sunny slopes of hills and hedge-banks, bramble clumps, nettle beds, heaps of stones and sunny places in woods ; but we have also found it in heathy and grassy places that were distinctly and permanently wet. For food they appear to prefer small mammals such as mice, shrews and voles, young weasels ; but also take birds, lizards, slow-worms, frogs, newts, and large slugs. The young subsist for a time on insects and worms.

The Viper retires in autumn to a hollow under dry moss among the heather, under faggot stacks or into the discarded and leaf-covered ground nests of birds. They reappear about April, and may then be seen coiled on a sunny bank, apparently more concerned to absorb heat than to find food. They pair at this season, and the young (varying from five to twenty) are born in August or September. In this species, again, the eggs are retained until fully developed, and when the young see the light they are coiled up tightly in a thin, transparent membrane, which usually breaks during the process of birth. They measure from six to eight inches, and are at once independent.

The hoary old legend about the mother Viper opening her jaws to afford sanctuary to her young in time of danger has probably arisen from some occasional acts of cannibalism. It presupposes what is not true of any of our reptiles—that the young remain with their parent. They all begin life equipped for independence, and act accordingly.

The Viper is not so amenable to a life of captivity as our

other Snakes. It is not amiable, indeed its temper may be described as short and sulky, which it displays by refusing all offers of food ; most captive Vipers die of starvation, the "hunger strike" being their effective protest against the deprivation of liberty. On being captured they are always ready to bite ; but in a state of freedom the Viper is not the aggressive monster that is popularly supposed. It seems to depend largely upon its inactivity for escaping observation, but when it knows it has been discovered its immediate impulse is to seek cover. Accidents from Viper bites are rare in this country, where people go about well shod, and there are very few cases of authenticated death from this cause. On the Continent, however, such cases are frequent ; and it is suggested that in the warmer parts of Europe, where bare feet are more numerous, the Viper's venom may also be more active than it is here. It is the toes or fingers that are most likely to be bitten, for the Viper's mouth is not large enough to enable it to bite the larger parts. The mechanism by which the poison is introduced into the blood of its victim has been briefly described on page 146.

It must not be supposed from the foregoing remarks that we deprecate caution in dealings with the Viper ; but we do desire, if possible, to dispose of that senseless fear that is unworthy of man. If the victim is in bad health the bite of the Viper may involve very unpleasant consequences—even death, but this is much more likely to follow from the sting of a gnat ! In case of a bite from this species, the approved treatment is to suck the wound thoroughly and apply oil to it. The rustic remedy approved by quack doctors is an oil prepared from the Viper's own fat—"a hair of the dog that bit you" sort of cure. A ligament above the wound will prevent the poison spreading ; and the blood may be made alkaline by the internal administration of ammonia. The popular idea in many parts is that the reddish-coloured Vipers have more virulent poison than the



Pl. 90.

Viper or Adder.

Vipera berus.

L 150.



Pl. 97.

Edible Frog.
With vocal sacs inflated in "singing."

L. 157.

others, but there does not appear to be any good grounds for this differentiation.

The Viper is found in all parts of Britain, but is not known in Ireland.

Frog (*Rana temporaria*, Linn.).

With the Common Frog, popularly classed as a Reptile, we commence acquaintance with the zoological class Batrachia, creatures that begin life at a much lower stage of development and have to pass through a fish-like larval form before attaining to any likeness to their parents. The Reptiles get through these developmental stages whilst they are still in the egg; they never have water-breathing organs. The Batrachians or Amphibians are clothed with soft skin which is not protected by armour plates or scales as seen in the Lizards and Snakes, but through which they are able to oxygenate the blood. The Frogs, Toads, and Newts constitute a class intermediate in structure and development between the Fishes and the Reptiles. Our native species represent the two orders—Ecaudata (tailless), including the Frogs and Toads; and Caudata (tailed) comprising the Newts.

Everybody knows the Frog as well as they know any of the backboned animals, and every youngster even is familiar with the main facts of its development, from the jelly masses of eggs in the pond early in spring, through the tadpole stage to the attainment of four legs and wonderful leaping powers. It is common knowledge that he has a moist, smooth skin (the supersensitive erroneously say "slimy") of yellowish ground colour overlaid with streaks and spots of brown. There is a big patch of brown behind each eye, and the long hind legs have cross-bars of the same colour. The ground tint of the Frog varies in different individuals according to the situation in which we may find them; for the pigment cells of the skin expand and contract under the influence of varying intensities

of light reflected from the surroundings, causing colour changes much after the manner of those of the Chameleon, though less marked.

The Frog's fore limbs are very short compared with the hind pair, and the four moderate-sized fingers are not connected by webs; whereas, the hind limbs have their several bones



Skeleton of Frog.

lengthened, and the abnormal lengthening of those of the ankle gives the legs the appearance of having a supplementary joint. The leg is one and a half times the length of head and body. The foot has five long toes connected for half their length by a "web" of skin which constitutes a very efficient paddle when the Frog is in the water. Of these hind toes the fourth is considerably longer than the long third and fifth.

The Frog's head is as broad as it is long, the muzzle rounded,

and the horizontal gape of the mouth extends back beyond the eye. The prominent eyes are perched up on the forehead, and have a fine golden iris and a horizontal pupil. The Frog differs from the Snakes and agrees with the Lizards in having eyelids ; he has also, like the Birds, an additional lid—the nictitating membrane. There is a row of delicate teeth along the upper jaw, but none on the lower ; there are others on the palate. The deeply notched tongue is attached by its base to the front part of the mouth, the tip far in towards the throat ; in use it has to be suddenly turned over so that the tip is projected far beyond the muzzle. The large circular depression behind and below the eye is the drum of the Frog's ear.

The Frog has no neck, the base of his skull coming close to the collar-bones, and there are only a few pairs of very short apologies for ribs between the shoulders and the long pelvis which produces that steep incline at the rear of his back. He is clothed entirely with a smooth, soft skin, which is kept moist by the action of minute mucous glands distributed all over the body. A row of these glands of larger size forms a pale line running back from the eye on either side. The skin plays an important part in the oxygenation of the Frog's blood ; and the experimental physiologists have shown that a Frog deprived of its lungs can carry on its respiration for a lengthened period through the skin alone. Owing to the absence of ribs he has to fill his lungs by swallowing air.

The male is less portly than the female, and he is further distinguished by having two pads on the first finger which in the breeding season become large rough cushions enabling him to hold his mate. In his throat there is a pair of vocal sacs enabling him to produce his love songs, and when these are in use their inflation causes a distension of the skin of the throat ; but without these adjuncts the female manages to give answering croakings. When these duets are sung under water they produce some curious effects.

When the pairing season arrives—quite early, usually about the middle of March, but sometimes in February—all the Frogs that have just come out of hibernation select their mates. Any pool of water will do, however transient, and they often make mistakes in this matter, their egg-masses being left high and dry when the waters dry up. The eggs are deposited in a mass of a thousand to two thousand at the bottom of the water, and at first they are only about a tenth of an inch in diameter, but the gelatinous covering absorbs so much water that they swell up to a third of an inch. There is a corresponding lightening of the mass, which floats to the surface and is available for observation. Each of the little jelly-spheres is seen to have a black centre—the egg proper—with a white spot on the lower side. If the spring is an average one, in about four weeks' time the black specks will have developed into brown larvæ or tadpoles, and having escaped from the egg these will be clinging to the remains of the jelly mass by means of a pair of suckers on the underside of the head. There are at present no indications of limbs—head, body and tail, like those of a fish, merge one into another. Even the gills are not yet developed, though what we may term the buds of them are seen on the bars separating the slits behind the head on each side. These buds soon expand into gill-plumes through which the blood circulates, taking up oxygen from the water that passes between them. There is as yet no mouth, but this will soon open, and horny plates on its jaws will enable the tadpole to crop soft vegetable matter, upon which it subsists chiefly. Later on, the gill-plumes will be hidden by a flap which grows over them. The full series of stages in this development may easily be watched by keeping a few tadpoles in a glass of water with a little growing pond weed.

Ultimately, the limbs appear. Though all four develop simultaneously, the hind pair *appear* first, because the fore limbs are at first hidden by the flap which grew over the gills.



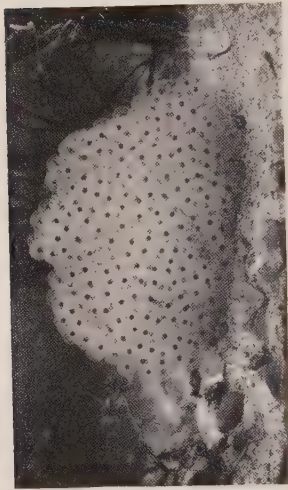
Fig. 98.

Common Frog.
Hyla lessonae.

Fig. 100.



Spawn mass soon after deposit.



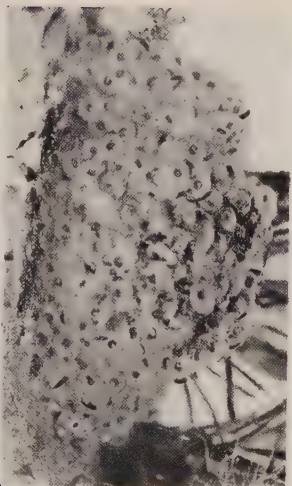
Eggs apparent after absorption of water.



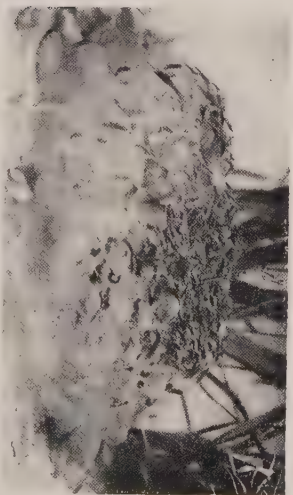
Germis assume Tadpole form.



Tadpoles begin to hatch out.



Immature Tadpoles on outside of egg-jelly.



Tadpoles begin to leave. Egg-jelly decomposing.





Pl. 101.

Edible Frog.
Rana esculenta.

M 161.

After the disappearance of the gill-plumes, proper lungs are developed inside the body, and the animal changes from a fish-like water-breather to an air-breather, in preparation for a life on land. When all the legs are well out the form of the tadpole soon changes to that of the Frog, except that it has a long tail. You may read in some books that the tail is shed, but this is a mistake that no one could make who has watched day by day the evolution of the Frog from the tadpole. The tail is *absorbed*; it gets smaller daily, until finally the hind body is rounded off and there is nothing left to indicate that it once ended in a tail. Ultimately the Frog may attain a length of head and body equal to four inches.

Mr. E. S. Goodrich, F.R.S., has recently demonstrated that eggs obtained from a female Frog by dissection can be fertilised by the leucocytes or colourless corpuscles of the blood. He exhibited a fatherless Frog, so obtained, before the Linnean Society in November, 1918.

When all the tadpoles have become real little Frogs, with their legs sufficiently firm to enable them to indulge in hopping exercises, they still for a time venture no further than the very shallow water at the extreme edge of the pond, where they can walk partially submerged. Then one day there comes a heavy summer rain storm—a deluge on a small scale. Every little Frog then appears to hear the word “Go!” for with one impulse they all scramble out of the pond into the jungle of wet grass, they know not whither. If there is a road near, that is the place in which to form an idea of their prodigious numbers. The few wayfarers who may be hurrying along that road, looking for possible shelter from the pitiless rain, and seeing the Frogs hopping along much as the raindrops bounce, are quite prepared to declare that they came down from the clouds with the rain. Many persons who in the ordinary affairs of life would be regarded as reliable witnesses have testified that this is what happens. To them it seems a much more reasonable explanation

of this sudden appearance—they term it a phenomenon—than the naturalist's statement that the Frogs had been waiting in the pond for the psychical moment to arrive for their dispersion—the time when the reeking herbage of many acres around would offer the safest conditions for their tender bodies to embark on the great adventure of life, their distribution over wide areas where they could carry out their proper function, the control of any inordinate increase in the insect population. For months they will crawl and hop invisibly among the lush grass and journey through the dense herbage of hedge-bottoms and spinneys. Some will come under fences even into our gardens, to help us in an unequal warfare in which the gardener is always defeated by the insect, whether the bigger combatant admits it or not. Their food consists entirely of insects, slugs, and worms. In turn the Frog constitutes the food of many larger animals, including fishes, birds, snakes and weasels. The winter is spent embedded in mud at the pond-bottom, or in damp holes in the earth.

The Common Frog is distributed widely all over Britain, but is only of local occurrence in Ireland. Abroad it ranges over Central and Northern Europe as far as Sweden and Norway, and eastward to Mid-Asia.

Edible Frog (*Rana esculenta*, Linn.).

Although the Common Frog is the only species that is really native in Britain, another one—the Edible Frog, a Continental species—has been naturalised in the Eastern Counties of England since the early part of the nineteenth century, when Mr. Geo. Berney brought about 1500 specimens from France and Belgium and turned them loose in the Fens, in the neighbourhood of Stoke Ferry, where they are no longer plentiful, though they occur locally in various parts of Norfolk. A few years later (1843) Mr. Thurnall discovered the species in the

Cambridgeshire Fens at Foulmire—a great distance (30 to 40 miles) from Stoke Ferry. Bell says his father had noted the presence of these Foulmire frogs, under the name of “Whaddon Organs,” about the middle of the eighteenth century; so that it appeared that Mr. Berney had “taken coals to Newcastle”—in other words, had introduced the Edible Frog to a part of England where it already existed. In 1884 Dr. G. A. Boulenger discovered that the Foulmire frogs were of the Italian form of *Rana esculenta* known as the variety *lessona*, which made it doubtful whether they could be travelled descendants of Mr. Berney’s frogs. So it was suggested that they were a survival from an introduction by the Romans—who are always dragged in to help out doubtful cases.

The difference in the French and Italian forms is mainly one of colour, the type being a beautiful grass-green, whereas *lessona* is olive-brown. But it has since transpired that *lessona* is not restricted to Italy as Boulenger thought, for he has more recently discovered it in Belgium and near Paris, and it has been recorded from parts of the former Austrian and German Empires. Such differences as there are in the two forms are not fundamental, and the brown tint of the Foulmire examples may be due to their environment. Fresh importations from the Continent have been liberated in recent years in Hampshire, Surrey, Oxfordshire, and Bedfordshire.

The Edible Frog attains to a rather larger size than the Common Frog. It is usually without the dark patch extending from the eye to the shoulder, and the markings of the body—especially the bright yellow and black marblings of the hinder parts—are darker and bolder. There is usually a light yellow or green line running down the middle of the back from the muzzle to the hinder extremity. The most distinctive feature, however, is restricted to the male sex: at the hinder angle of the mouth, just below the ear, are external vocal sacs which, when the owner is inclined to be melodious, become distended

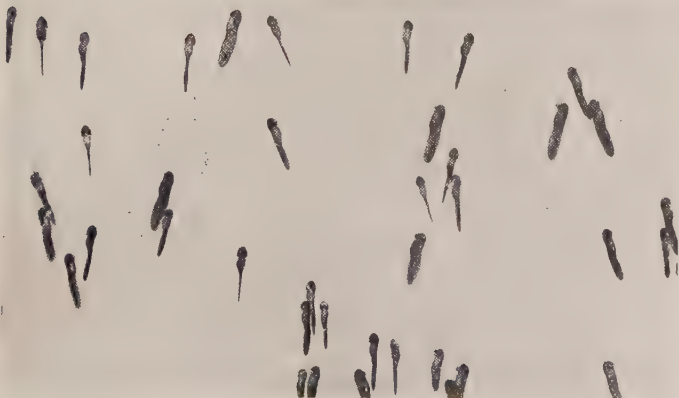
with air to the size of large peas, giving him a very quaint appearance. The croak differs from that of the Common Frog, and has been described as "more of a loud snore, exactly like that of the Barn Owl;" but this probably refers to the vocal efforts of the female, for Bell says it is so loud and shrill as to have obtained for the frogs the names of "Cambridgeshire Nightingales" and "Whaddon Organs." The males continue to "sing" after the breeding season is past, particularly on warm moonlight nights, when they may be heard for over a mile when the choir consists of several hundred voices. The notes are "Brekeke, gwarr, ooaar, coarx."

To return to a description of the Edible Frog. Full-grown examples measure from two and a half to four inches of head and body; the females larger than the males. The head is more slender than in the Common Frog, and the brown eardrum is two-thirds of the diameter of the eye. The teeth on the palate form two oblique lines; and there is a pair of glandular folds behind the eye. The ground colour of the upper parts ranges from dull brown through olive to bright green, with dark brown or blackish spots on the back and larger patches of similar tint on the limbs. There is usually a bronzy-brown line along each side of the back, in addition to the central one already named. The back of the thigh is always spotted with black and white or yellow. Though the thigh of the Common Frog is barred or blotched, it never bears these additional spots. The coloration generally is much brighter where the vegetation is light than in dark swamps with sombre vegetation.

The developmental history of the Edible Frog from the egg to the loss of the tadpole tail follows much the same course as that of the common species, and it is not necessary to recapitulate it. The eggs are more numerous, one female producing from five to ten thousand. The tadpole condition lasts three or four months. Full-grown tadpoles are about two and a half inches



Egg-ropes of Toad coiled around water-plants.



Pl. 102.

M 164.

Newly-hatched Tadpoles clinging to remains of egg-ropes.

Common Toad.



N. 103.

Common Toad.

N. 105.

long, of which more than an inch and a half is tail. The frog that has just got rid of his tail measures only half an inch. The young frogs are not such wanderers as their Common cousins, but remain in the vicinity of their birthplace, unless the pond dries up. They like to bask in the sun and wait till their food comes within range of their extensible tongues. They become mature between the fourth and fifth years.

This is the Frog whose hind legs are served as food in the restaurants of France and of the French quarters in London. We have not experimented with them as food, but remember that Frank Buckland, who was keen upon out-of-the-ordinary dishes, described them as "tasting more like the delicate flesh of the Rabbit than anything else I can think of." Our old friend, Miss Susan Hopley, told us that she once unwittingly partook of a much larger kind in the United States, and innocently remarked, "What a pity to kill such very young chickens!" She says she was moved to the remark by the insipidity of the dish.

The Edible Frog is found all over Europe and in Northern Asia.

The beautiful little Tree Frog (*Hyla arborea*), of bright green colour, with expanded toe-tips which make it an expert climber, is widely distributed on the Continent, whence it is frequently introduced to our conservatories. Some of these examples turned loose years ago in the Isle of Wight have become naturalised in some parts of the island, where they have become so numerous as to arouse complaints against their noisy nocturnal croaking during the breeding season.

Common Toad (*Bufo vulgaris*, Laurent).

Though in general terms the Toad may be said to be of similar form to the Frog, there is no need for a very minute

catalogue of differences to enable the reader to discriminate between the two. So well-known are both amphibians to sight that the majority of persons know them by their correct names on a casual glance ; yet we have met many who confuse them, and for this minority it is well to give some of the Toad's points.

He has a flatter back than the Frog, the bones of the pelvis not producing so sharp an angle ; and the hind legs are not so long in proportion to the body, only slightly exceeding the length of head and body, whereas in the Frog they are one and a half times that length. The Toad seems more solidly built than the Frog, with broader head, shorter limbs, and in general aspect is closer to the earth, a heavier, more grovelling creature than the vaulting Frog. This earthliness is accentuated by the texture and colour of his skin. Instead of the moist and shining, bright-coloured coat of the Frog we have a dry, dull, pimply skin so strongly resembling the earth that he is frequently passed by as a lifeless clod. That is one of the Toad's strong points ; and he has the patience to squat motionless for hours, tiring out any enemy that looks for movement as proof of life. He is too heavy to take a leap ; instead he progresses by very short jumps on all four feet which give the impression of being accomplished only by a great effort. But he rises alertly to his full quadrupedal height when he is considering the best way to negotiate a worm.

The colour of the Toad varies a good deal according to the nature of the soil upon which he happens to live. It is usually some tint of brown or grey, but the brown may be almost red in sandpits, a rich brown or a dirty brown ; the grey may be light or with an olive tinge or a sooty hue that may pass as black. As he is only active in the evenings and at night, any of these tints serve to render him inconspicuous in the general duskiness. Even his bright eyes, being coppery red in colour, do not serve to draw attention to him.



P. 104.

Natterjack Toad.
Bufo calamita.

N/ 166.



The pimples of various size that diversify his skin are not mere ornament, though they help materially to produce the clod-resemblance. They are glands that on occasion pour out an acrid and offensive fluid that often saves the Toad when he is caught up in the jaws of some unsophisticated carnivorous beast or bird. Experience teaches such enemies to leave the Toad alone. The largest of these glands—the parotid—may be seen as an elongated, porous swelling behind the eye. The underside is whitish, the white being qualified always with an admixture of yellow, brown, or red, sometimes spotted with black.

In the matter of size: taking the head and body for length, average males measure about two and a half inches and females an inch longer. Occasionally we may meet with much larger examples, and we may safely set down such monsters as females. The male has no vocal sacs, internal or external, as in the Frogs; but both sexes can croak with several variations of tone. These sounds are emitted much more freely in the pairing season. The male develops special grasping pads on the palm and three inner fingers, at the pairing time.

After the breeding season Toads wander away from the water, and distribute their forces over field, hedgerow, wood, and gardens, wherever there is an abundance of insect life, for the quantity of food each Toad consumes is enormous. It includes beetles, caterpillars, flies, snails, worms, woodlice, and small mice. If the droppings of a Toad be examined, they will be found to consist very largely of the indigestible parts of beetles. The Toad spends the hotter part of the day concealed under the lower foliage of plants, and as many nocturnal insects seek similar situations in the daytime, he has no difficulty in enjoying a continual feast. His appetite appears to be always keen, no matter how well he has fed. Some years ago, when we were pointing to a portly female in her favourite daytime “form” in the garden, a friend expressed the opinion that she

was overfed, and we remarked that you cannot overfeed a Toad. Our friend was sceptical, and undertook to provide more food than she could eat. There followed a hunt for the fattest caterpillars and the longest worms, and the Toad accepted them as readily as though she were breaking a fast. The caterpillar hunter grew tired of the business whilst the Toad was still quite fresh, and he admitted that with so elastic an integument there was no knowing what was the limit of a Toad's feeding capacity.

The Toad has the homing faculty well developed. By the judicious wriggling of his hind-quarters he scoops out a hollow in the soil, preferably under a root or stone, so that he can lie without being conspicuous. In the evening he sets out hunting, and may travel some distance ; but before morning he is back snugly in his form, where he may be found during the day for many months. A similar sense of locality—"orientation" the naturalists call it—is manifested in the choice of ponds for breeding. Any chance pool, however temporary in character, will serve the Frog, but the Toad is more particular and has special requirements for a nursery. Any one who has observed our batrachians during a series of years must have noticed that scores of Toads may be seen in early spring, all converging upon a particular pond, perhaps passing some other piece of water that looks quite suitable for their purpose. In a garden where we kept a portion wild as cover for many of the smaller animals, we had a considerable number of Frogs and Toads that had come there voluntarily. A small pond was freely visited by them, together with Newts, an occasional snake and stray aquatic birds. The Frogs and Newts bred there every year ; the Toads never. In a field two or three hundred yards beyond our boundary was a large deep pond that had formerly been a brickmaker's pit, but the suitable earth being exhausted it had been allowed to fill with water. To this pond Toads came in the spring from all quarters. On a mild moist evening

when the great impulse took possession of the Toads, we used to see scores of them hopping across a well-used road that divided the grass-lands, and next morning would see the lifeless bodies of many that had been flattened out by motor-wheels in the dark. On the further side of the pond the continuity of the grass-land was again broken by a railway line, and here you would see them hopping across the track and climbing over the rails, many, of course, meeting fate in the adventure.

In our present neighbourhood there is a large pond fed by springs from the plateau gravels of an extensive common. In the days of our boyhood there was open grassland and copse between the common and the pond with only an ordinary hedge to mark that it was private land. At the present time the pond forms a fine piece of ornamental water in a private garden, and on all sides residential roads surround it. Yet this pond must have been a Toads' breeding place in the old days, for in the spring we find Toads on the tarred sidewalks of the roads seeking for gaps in the fence through which they may reach the desired trysting place; and we have sometimes put them in the way of finding it. It is very probable that in such cases the Toads are making their way back to the identical pond in which they first saw the light—a corollary to the case of the migrant birds that find their way back to build their nests in the copse or hedgerow where they were hatched.

The small, black eggs of the Toad differ from those of the Frogs in the fact that they form a double row embedded in a gelatinous string ten to fifteen feet in length. Like those of the Frog the eggs by imbibing water swell to three times their original size. The strings are wound about the stems of water-weeds by the movements of their parents, and the little black larvæ are hatched out in about a fortnight. For the first few days they cling to the egg-strings, then hang tails downwards from the undersides of leaves. They go through similar stages to those of the Frog tadpole, and become small tailless Toads,

a little more than half an inch long, in eleven or twelve weeks. It is five years before they reach maturity ; but the full period of life is not known. In old age they frequently succumb to the attacks of flesh-eating flies whose eggs are deposited on the back of the Toad, and the small maggots entering by eye or nostril devour the brain and eyes.

The Common Toad is found all over England, Wales, and Scotland ; but Ireland appears never to have had it, in spite of the legend that St. Patrick banished it with the Snakes. It occurs all over Europe, through Siberia, the Amoor, and the Himalayas to China ; also on the further side of the Mediterranean, in Morocco, and Algeria.

Natterjack (*Bufo calamita*, Laurent).

Although in general appearance the Natterjack may be said to resemble the Common Toad, a close inspection reveals differences that at once distinguish it as a separate species. It is smaller than the common species and its legs are not only actually but also proportionately shorter. But the narrow yellow line that runs along the centre of the head and back is the most distinctive mark, and has suggested one of its local names—Golden-back. Running Toad is the name by which it is known in the Fens, and this is a good descriptive name, for owing to the shortness of the hind limbs the Natterjack does not hop. It runs for a short distance, then stops for a little, and runs on again.

The maximum length of head and body is three inches, and there is no marked difference in size between the sexes ; but the male develops nuptial pads on his first three fingers, and he has a large internal vocal sac whose use causes a great bulging of his bluish throat. The skin, though warty, is smooth ; its ground colour is pale yellowish-brown tending to olive, with clouding and distant spots of a darker brown or



Pl. 106.

Crested Newt, female,
climbing glass side of tank.

M 170.



Pl. 107.

Crested Newt. male.
Molge cristata.

M 171.

greenish hue. The underside is yellowish-white with black spots, and the legs are barred with black. The prominent eyes are greenish-yellow, and the long porous gland (parotid) behind the eye is smaller than in the Common Toad.

The Natterjack breeds later than the common species, the pairing not beginning before the end of April and being spread over May and June. Like the Frog, it is careless regarding the permanent nature of its spawning place. The locality chosen is advertised by the rattling noise of the males, a loud trilling croak continued for a few seconds at a time, and of sufficient power to be heard a mile away. The egg-strings are short as compared with those of the Common Toad, being only five or six feet in length. The blackish tadpoles are only an inch long when fully grown ; but they get through their development into tailless Toads in less than six weeks, and are then less than half an inch long. In another year they only measure three-quarters of an inch ; and when they become mature between the fourth and fifth years they are only between an inch and a half and two inches long.

The Natterjack feeds on insects and worms, and though its activities are mainly nocturnal, it may be seen running about in full sunshine. When molested it spreads itself out flat on the ground and pretends to be dead. The secretion from its glands when annoyed is said to smell "of gunpowder or india-rubber."

It is plentiful in some English localities, but it appears to be somewhat migratory, many places whence it may have been recorded last year failing to yield a specimen to the careful searcher this year. Sir Joseph Banks first called attention to it as a British species in the account published in Pennant's "British Zoology" (1776). Part of his note is worth quoting : "This species frequents dry and sandy places : it is found on Putney Common, and also near Revesby Abbey, Lincolnshire, where it is called the Natter Jack. It never leaps, neither does it crawl with the slow pace of a Toad, but its motion is liker to running.

Several are found commonly together, and, like others of the genus, they appear in the evenings."

In Scotland it is much more rare than in England; but in certain parts of Ireland, as around Castlemaine and Valentia Harbours in Co. Kerry, it is plentiful and known by the name of Natchet, which is probably an Irish corruption of Natterjack. In his bright and entertaining "Seventy Years of Irish Life," Mr. W. R. Le Fanu gives a native explanation of their continued presence in Kerry, in spite of St. Patrick's activities: "Notwithstanding all this, there still exists a species of Toad (the Natchet, I think) in the barony of Iveragh, in the west of Kerry. I was fishing in the Carah river the first time I saw them. I said to two countrymen, who were standing by, 'How was it that these Toads escaped Saint Patrick?' 'Well, now, yer honour,' said one of them, 'it's what I'm tould that when Saint Patrick was down in these parts he went up the Reeks, and when he seen what a wild and dissolute place Iveragh was, he wouldn't go any further; and that's the rason them things does be here still.' 'Well now, yer honour,' said the other fellow, 'I wouldn't altogether give into that, for av coorse the saint was, many's the time, in worse places than Iveragh. It's what I hear, yer honour, that it was a lady that sent them from England in a letter fifty or sixty years ago."

The Natterjack is found on the Continent from Denmark and Sweden to Gibraltar.

As we have naturalised representatives of the Continental Frogs here, so we have an isolated colony of the European Midwife Toad (*Alytes obstetricans*), established many years ago in what was then a nurseryman's garden at Bedford. The circumstances attending its introduction are not known, but the colony still exists. The female lays from twenty to fifty bright yellow eggs connected in a long string, which the male entangles around his thighs and retires with them to his hole until the embryos have reached the tadpole stage—a period of about six



Male in bridal attire.



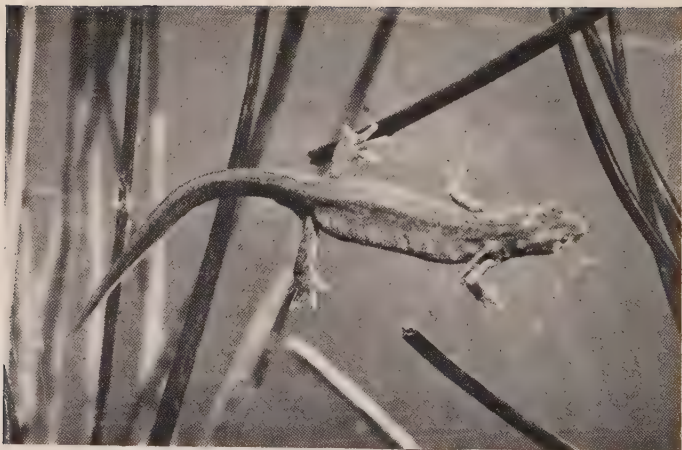
Pl. 108.

M 172.

Male, underside.

Smooth Newt.

Molge vulgaris.



Example with additional right fore-limb.



Pl. 109.

Cast-off skin.
Smooth Newt.

M 173.

weeks. At the proper time he seeks the water, when the tadpoles escape from the eggs, and complete their development much after the manner of Common Toad tadpoles.

Crested Newt (*Molge cristata*, Laurent).

The Newts, of which there are three British species, though agreeing generally with the Frogs and Toads in their passage through an aquatic, tadpole stage before attaining their mature form, differ in the fact that they retain through life the compressed tail. In consequence they constitute, with the Salamanders, the order Caudata or Tailed Batrachians. As the structure, development and habits of the three are much alike their story may be told here in general terms, before proceeding to a description of the species separately.

The entire animal is enclosed in a soft skin which develops mucuous and sensory apparatus, arranged principally along the sides and the base of the tail. The two pairs of legs are almost of the same length, the hinder pair being slightly the longer. The hands have four fingers and the feet five toes as in the other batrachians. In general form they are like Lizards, and Linnæus classified them as such and was followed by the naturalists of the earlier part of the nineteenth century. During the breeding season the skin of the males develops into a high crest or fin along the middle of the back. There is a similar development above and below the tail. These developments have a triple importance: they are sexual adornments, swimming aids and sensory organs. Usually terrestrial animals, the adults are impelled to seek the water at the pairing season, and in many cases travel long distances in order to reach the stagnant pools that are mostly favoured. There are minute teeth along the jaws and on the palate; but they serve only to retain their living food.

The skin serves the same office of respiration as we mentioned

in the case of the Frog, and like it they are compelled when on land to force air into their lungs by a constant pumping and swallowing action of the mouth and throat.

The male seeks to excite the female by displaying his beautiful crest and his heightened colours ; also by rubbing her with his head and lashing her with his tail. Then he emits spermatophores in the form of a mushroom-shaped gelatinous mass whose head consists largely of sperms. These sink to the bottom, whence the female takes them into her body. The eggs



Skeleton of Newt.

are, in consequence, already fertilised when deposited. They are laid singly against a long leaf of one of the pond-weeds—*Anacharis*, *Callitriche*, *Water-moss*, etc.—which is folded over by the female and adheres to the egg. They hatch in about a fortnight, the liberated larvæ being more slender and fish-like than the tadpoles of the Frog. They have three pairs of external gills, and soon after hatching they develop two pairs of thread-like organs from the sides of the upper jaw, which enable them to cling to water plants. The process of development is more prolonged than in the Frogs and Toads, but it is mostly complete at the end of summer before the hibernation begins. The little Newts then crawl out of the water and seek

shelter under stones in the immediate neighbourhood of the pond.

The Crested Newt, Warty Newt or Great Newt, is our largest species, attaining a maximum length of six inches, to which the tail contributes two inches and a half. The skin in this species is thrown into little warts, and on the upper parts is dark grey or blackish-brown. Along the lower part of the sides there is a liberal sprinkling of white dots, and the underside is coloured yellow or orange, boldly spotted or blotched with black. There is a strong collar-like fold at the base of the throat. The male's nuptial crest starts from the head as a low frill, but between the shoulders and the thighs becomes high with its edge deeply notched, the resulting "teeth" waving freely in the water. Behind the thighs there is a gap, and then the crest rises again as a tail fin, the lower edge of the tail having a similar extension. Along the sides of the tail proper runs a bluish-white, silvery-looking stripe. The eye has a golden yellow iris.

The female, who exceeds the male in size, is coloured similarly, but the lower edge of her tail is yellow or orange. Above the spine runs a depressed line, which is coloured yellow in the breeding season, which begins in April. The newly hatched, semi-transparent larvæ are yellowish-green with two black stripes along the back, which, later, when the ground colour changes to a light olive, become broken up into spots, and the flanks and underside become tinged with gold. They have a finer equipment of branchial plumes than the Frog tadpoles, and their form is more graceful and not "big headed." Some individuals do not complete their development before winter, and remain in the pond until the spring. They may be frozen in solid ice, but they thaw out none the worse for their cold storage. Their food consists of any small aquatic life such as insects, worms, crustaceans, and weaker individuals of their own kind; later, on land they feed upon worms and insects.

The adults, if they did not leave the water immediately after the conclusion of family affairs, seek dry land in the autumn, and assemble in numbers in some comfortable damp hole, where they twist and intertwine into a ball, apparently to prevent loss of moisture. In this way they pass the winter in a more or less torpid condition.

The skin is shed much after the manner of the Snake, separation beginning at the lips, and by the help of the hands and bodily wriggings worked off the tail. These sloughs may be found floating entire in the water looking like Newt-ghosts ; but on land they may be got rid of piecemeal, the old skin being sometimes swallowed as in the case of the Toad.

The Crested Newt is widely distributed over England, but is less plentiful in the west : in Devon it is a scarce species and locally restricted, and in Cornwall it does not occur. Much the same applies to Scotland, where it is found as far north as Perthshire, but not at all in the west. It is absent entirely from Ireland ; but generally distributed on the Continent.

Smooth Newt (*Molge vulgaris*, Linn.).

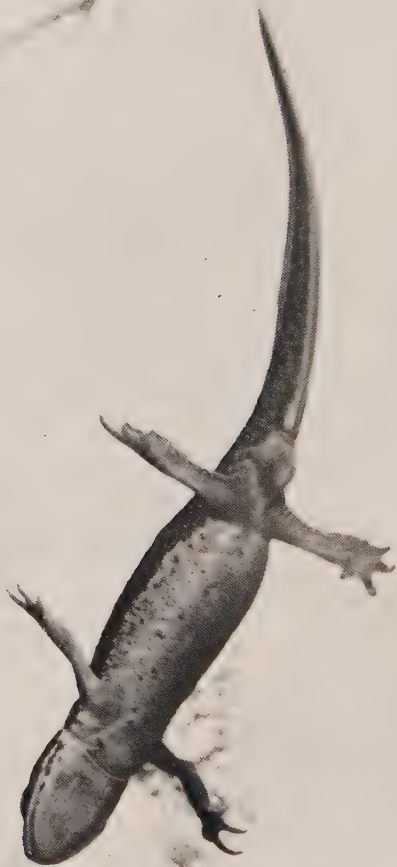
The Smooth Newt, Common Newt, Spotted Newt, Eft or Evat is the best known of the trio, but is most plentiful in the eastern half of the Kingdom. It is very much smaller than the Crested Newt, its maximum length being four inches. It varies in colour, but the prevailing tint is olive brown with darker spots over the upper side, and dark streaks on the head. The underside is orange or vermilion with round black spots, the colours becoming more intense in the breeding season ; the throat white or yellow, mostly dotted with black. The underside of the female is, as a rule, much paler than that of the male, and often unspotted. At the mating period the male develops a continuous crest, running from the top of the head to the end of the tail, and the lower edge of the tail has a spotted pale blue

Pl. 110.

Palmate Newt, male.
Molge palmata.

Pl. 176.





band with black base. The upper edge of the crest is festooned instead of being serrated. The eye has a golden iris. The female has shorter fingers and toes than the male.

The breeding history of the Smooth Newt follows much on the same lines as that of the Crested Newt. The larva is spotted with yellow along the sides and tail, which ends in a threadlike prolongation of its tip.

Immediately after the breeding season the adults leave the water, and seek their food among the vegetation of the land. They become duller in colour, and the skin becomes more opaque with a fine velvety surface. They are then the Dry Evats of country folk. When aquarium-keeping was a fashionable drawing-room hobby in mid-Victorian days the Smooth Newt was an annoying pet, owing to its objection to remaining in the water after the breeding season had passed, and being so frequently found in a dry and shrivelled condition in obscure corners of the room.

In parts of Ireland it is the Man-eater or Man-keeper (as well as Dry Ask and Dark Lewker) owing to a superstitious belief that it enters the mouths of sleepers, and thereafter robs them of all nutriment of which they may partake.

Palmate Newt (*Molge palmata*, Dum. and Bibr.).

In general appearance the Palmate Newt is similar to the Smooth Newt, and is as smooth as that species. There is no doubt that it is commonly mistaken for it, for a few years ago it was considered rare, but closer examination shows that whilst it is local in the south-east of England, it is more plentiful than the Smooth Newt in the west.

It is a smaller animal than the Smooth Newt, its length being three inches only. In the breeding season its distinctness is evident, for the male has then a nearly four-sided body owing to the development of a fold of skin along each side of

the back. The crest, instead of being high in front and having an undulating edge, rises gradually from the head, is of less height and has an entire margin. The tail appears as though the tip had been cut off and the attempt to renew it had got only as far as the development of a short thread from the centre of the cut portion. But what gives the species its name is a black web which connects the toes. The tail develops a fin along its lower edge in both sexes, and this in the male is edged with blue and in the female with orange. Another point of distinction lies in the colour of the throat. Instead of the black-dotted white or yellow of the Smooth Newt, the throat of the Palmate Newt is flesh-coloured without dots.

Above, the colour is olive-brown with darker spots ; below, the centre is orange bordered by pale yellow, with or without black spots.

After the breeding season, when the adults leave the water, the webbing of the feet—being no longer useful—becomes reduced to a margin along each toe and no longer constituting a palm ; but the truncated tail remains as a specific distinction, though the thread-like prolongation becomes very short in the female.

CLASSIFIED INDEX

TO ORDERS, GENERA, AND SPECIES DESCRIBED IN THIS WORK.

Mammalia.

Order Insectivora.

Talpa europæa, Linn., 13

Sorex araneus, Linn., 21

„ *granti*, 25

„ *minutus*, Linn., 25

Neomys fodiens, Schreber, 27

Erinaceus europæus, Linn., 9

Order Chiroptera.

Rhinolophus ferrum-equinum,
Schreber, 34

„ *hipposideros*, Bech-
stein, 36

Myotis bechsteinii, Kuhl, 40

„ *daubentonii*, Kuhl, 41

„ *mystacinus*, Kuhl, 37

„ *nattereri*, Kuhl, 39

Vespertilio murinus, Linn., 45

„ *pipistrellus*, Schreber, 43

„ *serotinus*, Schreber, 44

Nyctalus leisleri, Kuhl, 48

„ *noctula*, Schreber, 46

Plecotus auritus, Linn., 49

Barbastella barbastellus, Schreber, 51

Order Carnivora.

Vulpes canis, Linn., 52

Meles taxus, Boddaert, 55

Lutra vulgaris, Erxleben, 59

Mustela erminea, Linn., 66

„ *hibernicus*, Thomas, 69

„ *martes*, Linn., 63

„ *nivalis*, Linn., 69

„ *putorius*, Linn., 73

Felis silvestris, Schreber, 75

Order Rodentia.

Oryctolagus cuniculus, Linn., 113

Lepus europæus, Pallas, 117

„ *hibernicus*, Bell, 123

„ *timidus*, Linn., 121

Muscardinus avellanarius, Linn., 82

Evotomys alstoni, Barrett-Hamilton,
112

„ *erica*, Barrett-Hamilton,

113

„ *glareolus*, Schreber, 110

„ *skomeriensis*, Barrett-
Hamilton, 112

Microtus agrestis, Linn., 105

„ *orcadensis*, Millais, 109

Arvicola amphibius, Linn., 102

Apodemus flavicollis, Melchior, 91

„ *fridiariensis*, Kinneare, 92

„ *hebridensis*, de Winton, 92

„ *sylvaticus*, Linn., 89

Micromys minutus, Pallas, 86

Epimys norvegicus, Erxleben, 97

„ *rattus*, Linn., 95

Mus muralis, Barrett-Hamilton, 94

„ *musculus*, Linn., 92

Sciurus vulgaris, Linn., 78

[„ *cinereus*, Linn., 81]

[*Tamias striatus*, Linn., 82]

Order Ungulata.

Cervus dama, Linn., 130

„ *elaphus*, Linn., 124

Capreolus caprea, Gray, 133

Reptilia.

Order Lacertilia.

Lacerta agilis, Linn., 140

„ *vivipara*, Wagl., 136

[„ *muralis*, Merr., 142]

[„ *viridis*, Linn., 142]

Anguis fragilis, Linn., 142

Order Ophidia.

Tropidonotus natrix, Linn., 146

Coronella austriaca, Lacepede, 152

Vipera berus, Linn., 154

Batrachia.

Order Ecaudata.

Rana temporaria, Linn., 157

[„ *esculenta*, Linn., 162]

[*Hyla arborea*, Linn., 165]

Bufo calamita, Laurent, 170

„ *vulgaris*, Laurent, 165

[*Alytes obstetricans*, Laurent, 172]

Order Caudata.

Molge cristata, Linn., 173

„ *palmata*, Dum. and Bibr., 177

„ *vulgaris*, Linn., 176

INDEX

ADDER, 154, Plates 92, 94, 96
 Alexandrine Rat, 97, Pl. 61
 Alpine Hare, 121, Pl. 79
Alytes obstetricans, 172
Anguis fragilis, 142
Apodemus butei, 92; *A. flavicollis*,
 91; *A. fridariensis*, 92; *A. hebri-*
densis, 92; *A. hirtensis*, 92; *A.*
syriaticus, 89
 "Art of Learning," 2
Arvicola amphibius, 102
 Ask, 177

 BADGER, 55, Pl. 37
 Bank Vole, 110, Pl. 71
Barbastella barbastellus, 51
 Barbastelle, 51, Pl. 33
 Barn Rat, 100
 Bat, Barbastelle, 51; Bechstein's B.,
 40; Common B., 43; Dauben-
 ton's B., 41; Great B., 46;
 Horse-shoe B., 34; Leisler's B.,
 48; Long-eared B., 49; Nat-
 terer's B., 39; Noctule B., 46;
 Parti-coloured B., 45; Red-grey
 B., 39; Whiskered B., 37
 Bechstein's Bat, 40
 Blind-worm, 142
 Bony structure of Vertebrates, 4
 British Rat, 95, Pl. 62

Brown Hare, 117, Pls. 75, 77; B.
 Rat, 97, Pls. 63, 64
Bufo calamita, 170; *B. vulgaris*, 165
 Bush Rabbit, 116
 Bute Field Mouse, 92

CAPREOLUS caprea, 133
 Carnivora, 52
 Cat, Wild, 72, Pl. 46
 Catamount, 77
 Cat-a-mountain, 77
Cervus dama, 130; *C. elaphus*, 124
 Chipmunk, 82
 Chipping Squirrel, 82
Coronella austriaca, 152
 Crested Newt, 173, Pls. 106, 107

 DARK Lewker, 177
 Daubenton's Bat, 41, Pl. 21
 Deaf Adder, 142
 Deer, Fallow, 130; Red D., 124;
 Roe D., 133
 Dental Formula, 6
 Dog-mouse, 105
 Dormouse, 82, Pls. 52, 55
 Dry Ask, 177

 EFT, 175
Epimys hibernicus, 99; *E. norve-*
gicus, 97; *E. rattus*, 95

Erinaceus europæus, 9

Erinacidæ, 13

Ermine, 66, Pl. 41

Evotomys alstoni, 112; *E. erica*, 113;

E. glareolus, 110; *E. skomeriensis*,

112

Evat, 177; Furze Evvet, 139

FAIR ISLE FIELD MOUSE, 92

Fallow Deer, 130, Pls. 78, 82

Fawn, 132

Felis silvestris, 75

Ferret, 75

Field Mouse, Bute, 92; Fair Isle

F.M., 92; Hebridean F.M., 92;

Long-tailed F.M., 91; St. Kilda

F.M., 92; Short-tailed F.M., 105,

Pls. 67, 69

Fitchew, 73

Flesh-eating Mammals, 52

Foulmart or Foumart, 73

Fox, 52, Pls. 34, 35

Frog, Common, 157; Edible F.,

162; Tree F., 165, Pls. 97-101

Furze Evvet, 139

GNAWING MAMMALS, 78

Golden Back, 170

Grass Mouse, 108

,, Snake, 146, Pls. 91, 92, 93

Great Bat, 46, Pls. 13, 26, 29

,, Newt, 173

Green Lizard, 142

HAIR, characteristic of Mammals
alone, 7

Hairless Mouse, 94; H. Rat, 100

Hare, Alpine, 121; Brown H., 117;

Irish H., 123

Harvest Mouse, 86, Pls. 54, 56

Hebridean Field Mouse, 92; H.

Vole, 109

Hedgehog, 9, Pls. 1-4

Hind, 124

Hoofed Mammals, 124

Horse-shoe Bat, Larger, 34, Pls. 14,

15; Lesser H.B., 36, Pl. 17

House Mouse, 92, Pls. 58, 60

Huxley on Natural History Know-
ledge, 2

Hyla arborea, 165

INSECTIVORA, 9

Irish Hare, 123; I. Rat, 99

Islay Shrew, 25

LACERTA agilis, 140; *L. muralis*,

142; *L. viridis*, 142; *L. vivipara*,

136

Leisler's Bat, 48, Pls. 28, 30

Lepus europæus, 117; *L. hibernicus*,

123; *L. timidus*, 121

Lesser Shrew, 25

Lizard, Common, 136, Pls. 84, 85,

87; Green L., 142; Sand L., 140;

Wall L., 142

Long-eared Bat, 49, Pls. 31, 32

Long-tailed Field Mouse, 89

Lutra vulgaris, 59

MAMMALS, 4, 9

Man-eater, 177

Man-keeper, 177

Marten, 63

Meles taxus, 55

Micromys minutus, 86

Microtus agrestis, 105; *M. orcadensis*,

109

Midwife Toad, 172
 Mole, 13, Pls. 5-7
 Mole-heaves, 16
 Mole's "fortress," 16
Molge cristata, 173; *M. palmata*, 177; *M. punctata*, 176
 Mouse, Dog, 105; Dor M., 82; Field M., 91; Grass M., 108; Hairless M., 94; Harvest M., 86; House M., 92; Marsh M., 105; Wood M., 89
Mus muralis, 92; *M. musculus*, 92
Muscardinus avellanarius, 82
Mustela erminea, 66; *M. eversmanni*, 75; *M. hibernicus*, 69; *M. martes*, 63; *M. nivalis*, 69; *M. putorius*, 73
Myotis bechsteini, 40; *M. daubentonii*, 41; *M. mystacinus*, 37; *M. nattereri*, 39

NATCHET, 172

Natterjack, 170, Pls. 104, 105

Neomys fodiens, 27

Newt, Common, 176; Crested N., 173; Great N., 173; Palmate N., 177; Spotted N., 176; Warty N., 173, Pls. 106-111

Noctule, 46

Nyctalus leisleri, 48; *N. noctula*, 46

OBSERVATION, 1

Orkney Vole, 109, Pl. 70

Oryctolagus cunicularis, 113

Otter, 59, Pls. 38, 39

PALMATE Newt, 177, Pls. 110, 111

Parti-coloured Bat, 45

Pine Marten, 63, Pl. 40

Pipistrelle, 43, Pls. 23, 25

Plecotus auritus, 49

Polecat, 73, Pls. 45, 48

RAASAY Vole, 113

Rabbit, Bush, 116; Common R., 113, Pl. 73; Stub R., 116

Rana esculenta, 162; *R. temporaria*, 157

Rat, Alexandrine, 97; Barn R., 100; Black R., 95; British R., 95; Brown R., 97; Hairless R., 100; Hanoverian R., 95; Irish R., 99; Roof R., 97; Tree R., 97; Water R., 102; White R., 101

Red Deer, 124, Pls. 76, 80

Red-grey Bat, 39, Pls. 19, 20

Rhinolophus ferrum-equinum, 34; *R. hipposideros*, 36

Ringed Snake, 146, Pls. 91, 92, 93

Rodentia, 78

Roe Deer, 133, Pls. 81, 83

Running Toad, 170

ST. KILDA Field Mouse, 92

Sand Lizard, 140, Pls. 86, 88

Sciurus cinereus, 81; *vulgaris*, 78

Serotine Bat, 44, Pls. 24, 27

Short-tailed Field Mouse, 105

Shrew, Common, 21, Pls. 9, 11; Islay S., 25; Lesser S., 25, Pl. 12; Water S., 27, Pl. 10

Slow-worm, 142, Pls. 89, 90

Smooth Newt, 176; S. Snake, 152, Pl. 95

Snake, Common, 146; Grass S., 146; Ringed S., 146; Smooth S., 152

Sorex araneus, 21; *S. granti*, 25; *S. minutus*, 25

Soricidæ, 13
 Spotted Newt, 176
 Squirrel, Chipping, 82; Common S.,
 78; Grey S., 81, Pls. 49, 51, 53
 Stag, 124
 Stoat, 66, Pls. 41, 42
 Stub Rabbit, 116
 Sweet Marten, 63

TADPOLES, 160

Talpa europæa, 13
 Talpidæ, 13
Tamias striatus, 82

Teeth, 5

Theromorpha, 3

Toad, Common, 165, Pls. 102, 103,
 105; Midwife T., 172; Natterjack
 T., 170; Running T., 170, Pls.
 104, 105

Tree Frog, 165

Tropidonotus natrix, 146

UNGULATA, 124

VERTEBRAL Column, Regions
 of, 4

Vertebrates, 3

Vespertilio murinus, 45; *V. pipi-*
strellius, 43; *V. serotinus*, 44

Viper, 154, Pls. 92, 94, 96

Vipera berus, 154

Vole, Alston's, 112; Bank V., 110;
 Eigg V., 109; Field V., 105;
 Hebridean V., 108; Macgillivray's
 V., 109; Orkney V., 108; Raasay
 V., 113; Sanday V., 108; Skomer
 V., 112; Water Vole, 102; West-
 ray V., 108

Vulpes canis, 52

WATER Rat, 102; W. Vole, 102,
 Pls. 65, 66

Weasel, 69, Pls. 43, 47

Whiskered Bat, 37, Pls. 16, 18

Wild Cat, 75, Pl. 46

Wild Life, How to observe, 2

Wood Mouse, 89, Pl. 59

YELLOW-necked Mouse, 91





